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Passaic Valley Sewerage Commissioners
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PVSC Report

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Item 11a

REPORT UPON

OVERFLOW ANALYSIS

TO

PASSAIC VALLEY SEWERAGE COMMISSIONERS

PASSAIC RIVER OVERFLOWS

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1976

ELSON T. KILLAM ASSOCIATES, INC.
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ABSTRACT

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OVERFLOW

A detailed study was conducted of the seventy-three combined sewer overflow systems within the jurisdiction of the Passaic Valley Sewerage Commissioners. The work included the identification and investigation of these systems in order to determine their location, physical characteristics, and extent of service area. The methodology of investigation included the physical examination of each overflow chamber to verify dimensions, elevations, pipe sizes, chamber condition, and other physical characteristics affecting overflow to the river.

Overflow measurements were made at each of the active overflow stations to relate the overflow to rainfall, where possible, and to study time-duration pollution loading to the river.

Sampling of such overflows was undertaken to determine the quality of the combined overflow. Alternative plans for corrective action were considered and are reported, together with estimates of cost. It is recommended that the solution to problems of overflows experienced in the system be developed through the use of underground storage as the most feasible alternative, considering all factors.

This report is submitted in fulfillment of the agreement between the Passaic Valley Sewerage Commissioners and Elson T. Killam Associates, Incorporated, dated August 19, 1974. The original scope of work was set forth in the "Overview Report Upon Infiltration/Inflow Study of the Passaic Valley Sewerage Commissioners' District" dated May, 1974, under Construction Grant No. C340430-01-0.

PREFACE

PREFACE

In accordance with the agreement between The Passaic Valley Sewerage Commissioners and Elson T. Killam Associates, Inc., Environmental and Hydraulic Engineers, dated August 19, 1974, and approved by the United States Environmental Protection Agency, a Final Report upon Overflow Analysis is hereby submitted, setting forth the findings, conclusions and recommendations, in accordance with the requirements of the agreement.

The Table of Contents indicates the report topics, the initial sections begin introductory information such as "Purpose of Report", "Scope", and "Methodology". The first section of the detailed body of the report discusses the general approach followed to develop the data required for a project of this magnitude and complexity. The other four sections in the body arrange the overflows in geographical groupings, from the northerly terminus of the PVSC interceptor in the Paterson Area to the southerly portions of the PVSC District in the Newark and Kearny-Harrison Areas.

The final conclusions and recommendations concerning the Overflow Study and Analysis are included ahead of the "Summary Report Upon Overflows into the Passaic River" to be found following the Table of Contents.

Appreciation and thanks are extended to all those who assisted in this task and helped to bring this phase of the work to completion. Special thanks are extended to the laboratory staff of PVSC, who did the sampling analysis, to the field personnel, whose cooperation was invaluable, and

particularly to Mr. S. Lubetkin, Chief Engineer, Mr. E. Moller, Mr. J. Lawrence, and their staff, without whose cooperation and assistance the work could not have been completed.

ELSON T. KILLAM ASSOCIATES, INC.

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CONCLUSIONS AND RECOMMENDATIONS

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This study and report upon the Passaic Valley Sewerage Commissioners' Interceptor and tributary collection systems, serving an area of approximately one hundred square miles, covers both Infiltration/Inflow Analysis as well as an investigation of combined sewer overflows. Combined sewers are located in about twenty-four percent of the area served. Seventy-three overflows are located within the PVSC District, and these provide an outlet for about sixteen square miles of combined sewer area located within the District. About three square miles of combined sewers are located within the PVSC District but do not have PVSC overflows. Some of these overflows provide an outlet for sanitary sewer systems while the bulk serve combined systems. Sixty-five overflows are classified active, while eight are classified as inactive.

During the course of the study, it was found that approximately twenty-three additional overflows or bypasses owned by the City of Paterson are located within the City's collection system and discharge combined sewage directly into storm sewers which empty into the Passaic River. These are additional to the twenty-eight overflows classified active and located in the Paterson area which are part of the PVSC system.

It was also found that at least fourteen overflows owned by the City of Newark are located within the City's collection system and discharge combined sewage into storm sewers which empty into the Passaic River or Newark Bay. These are additional to the fifteen PVSC overflows classified active which are located within the City of Newark.

Three major overflows included in the foregoing, namely, Peddie, Queen, and Waverly, are located in the South Side of the City of Newark which is served by combined sewers. The overflows from the South Side of Newark discharge into Newark Bay.

Measurements were made at all of the active PVSC overflow chambers to determine the rate and volume of overflow, as well as the degree of pollution resulting from these overflows during storm periods. A comparison was made of the quality of the combined storm water overflow with the dry weather sewage flow which was measured at both the sixty-five active and the eight inactive overflow stations within the PVSC system.

Measurements of overflow were conducted over a period of a year. It was found that rainfall occurred on one hundred and four days during the one-year period of study. Furtheremore, overflows occurred from seventy to eighty times per year during the period of study. Overflows generally occurred within fifteen to twenty minutes after rainfall intensity exceeded 0.04 inches per hour. The duration of the overflow period generally coincided with the time of rainfall and overflow has been found to occur for only short periods following reduction of rainfall intensities. The peak overflow rates were found to be extremely high, ranging from twenty to thirty times the dry weather flow in the collection system tributary to the overflow chamber. The volume of overflow was found to be a function of rainfall intensity, duration

of the storm, and the total rainfall. It was generally found that the initial overflows contained a higher degree of pollution than found in waste characteristics of the dry weather flow. Investigation of samples at the start of overflow indicated that the suspended solids were generally high, reflecting a flushing action through the sewers. The Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in the overflow were often a function of the non-storm waste characteristics of the tributary area. However, after some initial modest reactions no general evidence was found in storm water characteristics which would indicate a major and continued decrease in pollutional strength when storm water overflows extended over a long time period.

The suspended solids indicated a wide variation in concentration and appeared to have no correlation with the storm overflow rates and duration. The strength of BOD and COD were generally found to be somewhat lower following an initial period of overflow. Investigation of the combined sewer system overflows reveals that approximately 7,600 Million Gallons (MG) of combined storm water and sewage were discharged into the Passaic River during the study period (1974-1975). This volume is equivalent to about eight percent of the total annual sewage flow treated at the plant during the same period. The result of this overflow and other local overflows (not owned by PVSC) located within the collection system is a measurable pollution load upon the receiving stream. It should be noted that the overflow observed, represents flow from combined sewers serving 16 square miles of the PVSC Area and furthermore represents the excess flow which initially is conveyed by the PVSC interceptor.

The remaining storm flow from the balance of the PVSC Area (about 84 square miles) discharged in excess of 40,000 MG during the same study period, via storm drains, also with a measurable pollutional load on the River.

It has been estimated that the total annual pollutional loading from the combined sewer overflows in the PVSC District aggregates about 4,800 tons of BOD per year, for the study period. It should be noted that the study year (1975) was found to be the second highest rainfall year of record. Subsequently, it is presumed that a proportionate condition of runoff to the Passaic River prevailed during the same period, that is, extremely high river volumes of flow.

The annual loading to the river from PVSC overflows occurs usually during storm periods and its effect on the river is complicated by: increased river flow - higher velocities; storm water, and overland discharges along the river; tidal effects; and other factors which require a study far beyond the scope of this investigation. It was intended to study the effect of loadings on the River, utilizing the available River model prepared under separate contract for the State of New Jersey. The mathematical model could not be used because of its limitations under actual dynamic conditions. In other words, the formulation of a dynamic model by Killam Associates is well beyond the intent of the contract with PVSC. The data compiled during this study and reported upon certainly could be used and would be helpful in the formulation of a dynamic model. It is recommended that such study by undertaken to determine the true effect on the River.

Regardless of the effect on the River, Public Law 92-500 requires the objective of "zero" discharge by year 1985. The practicality of the timing of this objective notwithstanding, four alternative solutions have been considered, as follows:

1. Relief interceptor to accommodate storm water flows.
2. Reconstruct portions of sanitary and combined sewer system (separation and replacement).
3. Separation of combined sewer systems and construction of PVSC relief interceptor.
4. Alternative storage plans.

It has been determined that the most effective method of eliminating overflows is to provide storage (Alternative 4). This storage might best be provided by the construction of deep rock tunnels with adequate capacity to store combined overflows. It has been estimated that the storage required would be in excess of 700 Million Gallons (MG). This capacity should be adequate to accommodate the runoff from a four-inch rainfall over the nineteen square miles of the combined sewer It would then be possible to pump the stored combined flow into the treatment plant, which would be able to handle a flow in excess of the existing PVSC interceptor capacity. The cost of constructing a storage tunnel, and required pumping facilities, has been estimated to be approximately $700 million to $800 million.

The total collection system possible infiltration was found to range from about 70 MGD to 100 MGD. It has been determined that approximately 73 percent of this possible infiltration was located in the

combined sewer system districts. It has been estimated that approximately fifty percent of the possible infiltration can be reduced in both the sanitary sewer collection systems and the combined sewer systems in the District. Prior to undertaking a program of possible infiltration reduction, it would be advisable to determine whether or not overflows will be completely eliminated by the construction of deep storage tunnels or whether a combined sewer separation program will be undertaken. If a storage plan or separation program is authorized to be studied, it is recommended that the further investigation of possible infiltration under Phase II in the combined sewer system be limited to major and identifiable sources of possible infiltration that can readily be eliminated at nominal cost.

If the storage alternative is adopted as most effective, then preliminary engineering investigations should be made of the economic feasibility of constructing a deep rock tunnel for the storage of overflows. This investigation would include geological studies, borings, detailed estimates of cost, and alternative possibilities of subsurface storage to accommodate overflows which now occur.

It is recommended that whatever alternative is adopted regarding overflow, consideration be given to the effect of local overflows in the Paterson and Newark areas which now discharged directly or indirectly into the Passaic River, and which were not included within the scope of this report. This also includes the South Side Interceptor Sewer which is owned by the City of Newark, which now discharges into Newark Bay.

Determination of the most effective method of eliminating this overflow should also be included in any alternative adopted. It would appear that the installation of a deep rock tunnel would be the most effective means of eliminating such overflow, and a tunnel which would lead toward the Newark Bay Pumping Station, with its pumping facilities, could be integrated with the tunnel plan proposed for the combined sewer overflows from the Paterson-Newark area.

SUMMARY REPORT

UPON

OVERFLOWS INTO THE PASSAIC RIVER

SUMMARY REPORT
UPON
OVERFLOWS INTO THE PASSAIC RIVER

INTRODUCTION

One of the basic objectives of this study and report is to determine the most effective, economical, and environmentally acceptable means of controlling "combined" storm water overflows, and other sanitary sewage overflows created by severe inflow to the PVSC interceptor sewer, from the internal sanitary and combined sewer collection systems of the municipalities served by the PVSC.

The Water Pollution Control Act, Public Law 92-500, mandates that there be no overflow and no pollutional discharges by 1985. Although the goals set by the law are to be commended, their attainment within the time limits projected is doubtful from a practical view. The attainment of the objective of the law--elimination of all pollutional discharge by 1985, for all storm conditions--is not probable. The cost of this work is very great, and a massive public works project would be required to accomplish the objectives, insofar as the substantial elimination of all overflows and pollutional discharges is required.

ALTERNATIVES CONSIDERED

1. Relief Interceptor to Accommodate Storm Water Flows

Several alternatives have been considered in an endeavor to establish plans that might be economically feasible and within the ability of the PVSC members to finance, commensurate with the benefits received.

Consideration was given to the construction of a new parallel interceptor or trunk line extending from the upper terminus of the system in Paterson, a distance of about twenty miles, downstream to the Treatment Plant in the City of Newark. Spur lines would also be required under such a plan to substantially eliminate all overflow conditions which prevail within the collection system. Under this plan, it would be necessary to size the relief interceptor to accommodate the peak flow rates which now occur and which are exceptionally high in the Paterson, Newark, and Kearny-Harrison areas where combined sewers are in service.

This alternative has been evaluated and is clearly not economically feasible and should not be considered. A pipeline of this size and magnitude would have to accommodate peak flow rates from the Paterson area of about 5,000 to 7,000 MGD, and from the City of Newark and Kearny area, would have to be large enough to accommodate peak flow rates from 5,500 to 8,000 MGD, and 1,700 to 2,000 MGD, respectively. The cost of such an interceptor would be prohibitive, estimated to be about $1.0 to $1.5 billion. The diameter of the pipe would be exceptionally large, and the construction of such a line would involve deep tunneling in order to avoid disruption of existing utilities, traffic, and commerce.

In addition to the construction problems and tremendous cost of conveying these peak overflow rates to the plant for treatment, it would be necessary to provide expanded treatment facilities to treat the storm water, which would increase the estimated cost by $0.5 - $1.0 billion--which would not be considered economical.

The present treatment plant design calls for expansion and enlargement to handle an average daily flow of 300 MGD. Hydraulically, the plant will be able to accommodate at least twice this rate during peak flow conditions.

It is obvious from the foregoing that the expansion of the treatment plant to handle peak flow rates, which might be as high as 12,000 to 17,000 MGD--for relatively short periods--is not reasonable. For this reason, the installation of a new interceptor sewer to accommodate all overflows, whether from combined sewers in the Paterson, Newark and Kearny-Harrison areas, or inflows from the separate sanitary sewer systems, cannot be justified.

2. Reconstruct Portions of Sanitary and Combined Sewer System (Separation and Replacement)

Another alternative considered, involves the reconstruction and replacement of very old sewer systems in the PVSC service area with new pipelines, especially designed to provide watertight joints and appurtenances. Furthermore, new house connections are proposed in conjunction with the elimination of underdrains or illegal connections. Consideration was also given to separating existing combined sanitary sewers which are conducive to ground water infiltration and leakage. The objective of this plan would be to utilize existing combined sewers as storm sewer systems and provide new watertight separate sanitary sewers which would minimize the entry of ground water infiltration or inflow during periods of rainfall. Under this plan, a major portion of the older sanitary sewer systems would be reconstructed where inflow and infiltration are found to be excessive. The objective of the foregoing would be to reduce the storm flow rates in an attempt to avoid the necessity of paralleling or reconstructing the PVSC interceptor.

It has been estimated that there are approximately 8 million feet of both combined and separate sanitary sewers in the 100-square mile area served by the PVSC system. It has further been estimated that there are about 2.1 million feet of combined sewers in approximately 19 square miles of the District (exclusive of the South Side of the City of Newark), and the balance of the District is provided with separate sanitary sewer systems (5.5 million feet).

The estimated cost of reconstruction and repair of portions of the sanitary and combined sewer systems is about $1.2 billion. The construction of a completely new sanitary sewer system would be more expensive--about $1.8 billion--but this would essentially eliminate all infiltration and inflow. A combination of repair and replacement, as well as combined sewer separation, would significantly reduce both the dry weather flow rates and the peak flow rates (inflow) presently experienced.

Under present-day conditions, the average daily dry weather weekday flow at the plant ranges from about 250 MGD to 280 MGD (dry to wet weather months). Total system peak flow rates under storm conditions have been estimated to range from 2,000 to 15,000 MGD (storm water overflow conditions per occurrence). By new sewer construction and separation of the combined sewer system, it has been estimated that the dry weather flow could be reduced by about 50 MGD. The peak flow rates in the system would also be reduced.

Notwithstanding the reduction of extraneous flows--during dry weather and peak storm conditions--by the expenditure of about $1.8 billion for new sewer systems, it is estimated that overflows would still occur because of the inadequacy of the existing PVSC interceptor to accommodate anticipated peak flow rates.

It would therefore be necessary, under this alternative, to parallel a large portion, if not all, of the PVSC interceptor where capacity is inadequate. Therefore, this alternative is not considered feasible and we would not recommend any further detailed investigation of this concept.

A further consideration with respect to separation of combined sewers, other than expense, involves pollutional discharge during storms from separate storm sewers. Although separation diverts sanitary waste from the overflow, and essentially removes large portions of infiltration/inflow from the system, separate storm sewer discharges from urban runoff produce pollutional loads which are discharged to the River. These loads are variable and are in an order of magnitude which is dependent upon precipitation, road debris, chemicals, and other surface contaminants of a particular area. These contaminants are ultimately washed into and flushed through the storm sewer system, and discharged to the River.

3. Separation of Combined Sewer Systems and Construction of PVSC Relief Interceptor

Under this alternative plan, consideration has been given to a complete separation of combined sewers by the construction of a new, separate sanitary sewer system in approximately 19 square miles of the District now served by combined sewers. This alternative has the advantage of reducing the cost associated with a new sewer system for the entire District, and would eliminate "combined" storm water overflows which now occur with each measurable rainfall.

By eliminating the combined sewers in the Paterson, Newark, and Kearny-Harrison areas (12,200 acres), it has been estimated that the average daily dry weather weekday flows, which now range from 250 MGD to 280 MGD, seasonally, could be reduced to about 230 MGD.

It would still be necessary, however, to provide a parallel relief PVSC trunk sewer to prevent overflows into the river, since the estimated total peak system flow, which would include remaining inflow from the existing separate sanitary sewer collection systems, as well as the flow from the new sanitary sewer systems in the combined sewer districts, would be in excess of the carrying capacity of the existing PVSC interceptor.

Preliminary estimates of the cost of combined sewer separation by constructing separate sanitary sewer systems in the various areas of the District were determined to be as follows:

Paterson (5,100 Acres)	$185 million
City of Newark (5,400 Acres)	215 million
Harrison-Kearny Area (1,700 Acres)	80 million
TOTAL	$480 million

The area and cost shown for the City of Newark does not include the South Side area of the City (3,240 acres).

From the foregoing, it is evident that the cost of separation of the combined sewer systems is high. This is attributed in part to the fact that there will be: disruption to traffic; interference with existing utilities; premium costs for difficult working conditions in congested streets; extensive sheeting requirements; extensive pavement and curbing replacement; necessity to break existing connections to old sewers, maintain flows, rehabilitate old lines and provide complete separation in all combined sewer lines; and the necessity of reconstructing house connections in order to completely eliminate infiltration and to assure complete reduction of system inflow. It is believed that the foregoing preliminary cost estimates are conservative. However, the cost estimates may require modification following a full investigation of the effect of existing underground utilities and actual subsurface conditions, which can only be determined following extensive field surveys required prior to design. Construction cost contingencies in this type of reconstruction project must be higher than normally provided, because of indeterminate and uncharted subsurface conditions and interferen

which must be anticipated in highly developed areas.

Under this alternative, it would still be necessary to provide a PVSC relief interceptor to accommodate the peak flow rates to prevent overflows into the Passaic River during storms. The estimated cost of constructing approximately twenty-two miles of relief interceptor sewer and pumping facilities would be in excess of $350 million.

Thus, the total cost of constructing a new PVSC relief interceptor, and providing separate sanitary sewers in areas that are now provided with combined sewers, has been estimated to be about $850 million.

4. Alternative Storage Plans

Under this alternative, several methods have been investigated for handling storm water flows involving storage. The various methods which have been considered are set forth below:

(a) Provide local storage and treatment of storm water flows upstream.

(b) Provide storage and transport with treatment at existing Newark Bay Treatment Plant downstream.

(c) Separate the combined sewers and provide storage and transport with treatment at Newark Bay Treatment Plant.

(a) Provide Local Storage and Treatment of Storm Water Flows Upstream

Under this alternative, all storm water overflows which cannot now be accommodated by the existing PVSC interceptor sewer would be stored, and a local treatment facility for such stored storm water would be provided. A treatment facility would be located in the Paterson area, while similar treatment facilities would be located in Newark, as well as in the Kearny-Harrison area.

Storage facilities (tunnels) would be built underground. The treatment facilities would be activated during each storm to provide for the degree of treatment necessary to meet the requirements for discharge into the Passaic River--if permitted. Under most of these conditions, such discharge would be at times when the river flow is high, and the degree of treatment would be established to conform with the stream water quality conditions which prevail when non-point sources of pollution may predominate.

This plan is obviously not in conformance with the Federal Government mandate of no pollutional discharge into the receiving stream. The storage provided under this alternative would be adequate to accommodate the runoff from a total rainfall of four inches over the 19 square miles of the combined sewer area. A total aggregate storage of about 700 Million Gallons (MG) would be provided.

The pumping station and treatment facilities would be nominally designed with the view of dewatering the storage tunnels in a period of about one week following a four-inch rainfall occurrence. The cost of this alternative has been estimated to be from $750 to $800 million. This cost includes the capitalization of the operating costs.

(b) Provide Storage and Transport with Treatment at Existing Newark Bay Treatment Plant Downstream

This alternative would eliminate discharge of a treated effluent into the Passaic River upstream in Paterson and downstream in the Newark and Kearny-Harrison areas. All of the storm water overflows would be conveyed in a deep, long tunnel to the Newark Bay Pumping Station. Following a rainstorm, the stored combined sewage would be pumped at relatively low flow rates (about 100 MGD or less) into the existing PVSC treatment plant. The tunnel would have a storage capacity of about 700 MG, or equal to the estimated runoff from a four-inch rainfall over a 19 square mile combined sewer area.

The cost of this alternative has been estimated to be about $800 to $850 million. This is slightly higher (6-7 percent) in cost than the plan with local treatment and disposal in the Passaic River. However, this alternative does not require as much operation and maintenance.

(c) Separate the Combined Sewers and Provide Storage and Transport with Treatment at Newark Bay Treatment Plant

Under this alternative, all combined sewers in the Paterson, Newark, and Kearny-Harrison areas (12,200 acres) would be eliminated by constructing new separate sanitary sewers in these areas.

Underground storage tunnels would be constructed to store sewage overflows resulting from inflows into the existing sanitary systems (which would occur for short periods during heavy rainfalls because of the inadequate capacity of the PVSC interceptor). The stored overflows would be pumped at a relatively low rate into the PVSC interceptor in Paterson. This would occur after the rainfall. At the downstream end of the system, the stored water would be pumped directly into the Newark Bay Treatment Plant. The aggregate storage capacity required under this alternative is only about 90 MG.

The estimated cost of this plan--which appears to be the most economical means of eliminating all combined sewage overflow from the Passaic River--is $650 to $700 million. Of the foregoing amount, $480 million would be required for constructing separate sanitary sewers in about 12,200 acres of the District where combined sewers are in service (but not including 3,240 acres of combined sewers in the South Side of the City of Newark). The cost of storage tunnels and pumping facilities has been estimated to be from $170 million to $220 million.

Under this plan--and without reduction of infiltration in the rest of the system which has separate sanitary sewers--the average daily flow during the weekday (wet weather) periods might approximate 240 MGD, with peak flow rates substantially reduced.

It is furthermore estimated that a period of from seven to ten years might be required to implement this massive project. This elimination of combined sewage overflows and reduction of other extraneous flows, as indicated above, cannot be realistically completed before 1985, even if all the funds are made available.

This alternative does not include a cost allowance reflective of the loss to businesses and commerce in the center of Paterson and Newark, as well as in Kearny and Harrison, from the disruption to travel and inconveniences, and outright reduction in trade and commerce in the affected areas, nor does the alternative include the cost to homeowners and businesses for required sanitary plumbing separation within buildings and structures. Many buildings have roof leaders, cellar drains, and internal and external storm drains which would require separation, and this cost would be borne by the individual building owners. The above alternative costs would not be encountered if the tunnel plan--without combined sewer separation--were adopted.

These considerations, combined with environmental factors, must be weighed in selecting the most advantageous plan for elimination of storm water overflows.

A summary of the estimated costs of the various alternatives discussed is included in the following table:

SUMMARY OF ESTIMATED COSTS

Alternative Plans upon Elimination of Storm Water Overflows into the Passaic River

	ESTIMATED COST
1. Relief Interceptor to Accommodate Storm Water Flows:	$1.5 - $2.5 billion
2. Reconstruct Portions of Sanitary and Combined Sewer System (Separation and Replacement):	$1.2 - $1.8 billion
3. Separation of Combined Sewer Systems and Construction of PVSC Relief Interceptor:	$850 million
4. Alternative Storage Plans:	
(a) Provide Local Storage and Treatment of Storm Water Flows Upstream:	$750 - $800 million
(b) Provide Storage and Transport with Treatment at Existing Newark Bay Treatment Plant Downstream:	$800 - $850 million
(c) Separate the Combined Sewers and Provide Storage and Transport with Treatment at Newark Bay Treatment Plant:	$650 - $700 million

DETAILED REPORT

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PURPOSE OF REPORT

The Water Pollution Control Act Public, Law 92-500, mandates that there be no overflow and no pollutional discharges into rivers and streams by 1985. Accordingly, the basic objective of this report is to determine the most effective, economical, and environmentally acceptable means of eliminating the combined storm water overflows which occur along the Passaic Valley Sewerage Commissioners' main and branch interceptors, as well as the severe inflow from the sanitary sewer collection systems of the municipalities served by PVSC.

SCOPE

A detailed study was conducted of the seventy-three (73) combined sewer overflow systems within the jurisdiction of the Passaic Valley Sewerage Commissioners. The work included the indentification and study of these combined sewerage systems in order to determine their location, physical characteristics, and extent of service areas. The methodology of investigation included the physical examination of each overflow/regulator complex to determine its location, and verify demensions, elevations, pipe size and lengths, general condition, as well as other data deemed relevant.

Dry weather and wet weather flow measurements were also conducted (as part of the Infiltration/Inflow work). Overflow measurements were made at each of the overflow stations to relate the overflow to rainfall, where possible, and to develop time-duration pollutional loading curves to establish both peak overflow rates and total quantity of overflow, insofar as was possible.

Sampling of such overflows was undertaken to determine the quality of the bypassed storm water flow and its effect on the Passaic River. Such samples were analyzed at the laboratories of the Passaic Valley Sewerage Commissioners. The results of these analyses are included in the appendices to the individual overflow reports for each major geographical area.

Dry weather (non-rainfall) samples of the tributary sewage flow from the local interceptors at each overflow chamber were also

obtained to serve as a baseline of values. These baseline samples were also analyzed at the PVSC Laboratories for the same sewage parameters as for the storm overflow sampling. These results are also presented in the appendices of the individual overflow reports These baseline analyses facilitate a broad comparison of the sewage quality during periods of non-rainfall with that of the overflow to the Passaic River during periods of rainfall.

DEFINITIONS

BYPASS (noun) - An arrangement of pipe, conduit, gates, pumps, valves, etc., whereby the flow may be passed around a hydraulic structure or treatment facility.

(verb) - The act of causing flow to pass around a hydraulic structure or treatment facility.

COMBINED SEWER - A sewer which carries sanitary sewage with any component domestic, commercial, and industrial wastes at all times and which, during wet weather periods, serves as the collector and transporter of storm water from streets or other points of origin, thus serving a "combined" purpose.

DIVERSION CHAMBER - An enclosure within or adjacent to the regulator, which acts to conduct flow from an influent sewage line to the regulator chamber under dry weather conditions. During wet weather (bypass conditions), the flow is directed to the tide gate chamber.

DRY WEATHER FLOW - The combination of sanitary sewage and industrial and commercial wastes normally found in the sanitary sewers during the dry weather season of the year, and sometimes referred to as baseline flow.

FORCE MAIN - A pressure pipe joining the pump outlet at a wastewater pumping station with a point of gravity flow.

INTERCEPTOR SEWER - A sewer that receives dry weather flow from a number of transverse sewers or outlets, and frequently, additional predetermined quantities of storm water admixed with sanitary flows, and conducts such wastewaters to a point for treatment or for disposal.

mg/l - milligrams per liter, or the concentration of pollutional characteristics in sewage.

MGD - Million Gallons per Day -- a common term for rate of wastewater flow.

MG - Millions of Gallons -- a common term for volume of wastewater.

OUTFALL SEWER - The outlet, structure, or sewer through which sewage is finally discharged.

OVERFLOWS - The overflowing of trunk or interceptor sewers resulting from the combination of extraneous flows and normal flows which exceed the diversion capacity of the stop logs, stop planks, dam, or weir.

ACTIVE - An overflow which operates automatically or by manual operation to relieve an overflow condition.

INACTIVE - An overflow that, generally, has been taken out of service, either by closure of a gate or valve, or by an installed plug.

REGULATOR - A semi-automatic or automatic regulator device with movable parts that are sensitive to hydraulic conditions at their points of installation and are capable of adjusting themselves to variations in such conditions.

REGULATOR CHAMBER - An enclosure containing the regulating mechanism.

SAND CATCHER - A chamber located ahead of the regulator connection to the PVSC interceptor which acts as a grit collector. Sand, grit, and other suspended matter are intercepted and retained in this chamber, which is cleaned out periodically.

STOP LOG OR STOP PLANK - A dam or weir, usually constructed of brick, wood planks, or concrete, which is located at the entrance to the overflow outfall line, and which diverts normal sanitary (non-rainfall) flow to the interceptor through the regulator.

TIDE GATE CHAMBER - An enclosure adjacent to the regulator which acts to conduct the sewage flow (usually bypass) through a tide gate to the outfall. A rising tide seats the tide gates, thereby preventing tidal waters from entering the sewerage system.

TRUNK - A large sewer which receives wastewater from tributary branch sewers serving generally one drainage area.

METHODOLOGY

1. A tabulation has been made of the average daily flows measured at the Passaic Valley Treatment Plant for the entire year of 1974-75, including estimates of overflow due to valve closings, and special pumping practice. In addition, the rainfall data has been plotted to determine true dry and wet weather flow conditions, verifying the previously enumerated data regarding dry weather flow conditions.

2. The wet weather flow conditions have been evaluated, determining and tabulating areas tributary to combined sewer overflows into the Passaic River. The catchment areas investigated under various rainfall intensity and storm recurrence frequencies indicate the amount of wet weather or storm flow conveyed by these combined systems, as part of the total flow conveyed. These amounts have also been tabulated.

3. Estimates have been made of the discharge volume to the river, via the overflows under the various storm intensities,and these have been tabulated, as well as tabulating the anticipated peak flow rates.

4. The overflows have been analyzed based on observed conditions and in terms of major discharges to the Passaic River. These have been grouped in the major areas of Paterson, Newark, and all others (being of lesser importance). Additionally, the Second River Overflow (being entirely sanitary) has been studied as a separate entity, but related to PVSC trunk capacities available.

5. The overflows have been studied and analyzed on the basis of available capacities in the PVSC trunk and combined flows have been equated along the trunk on an inflow/outflow basis in an attempt to determine weaknesses of the system.

6. Analyses of water quality measured during the overflow under various rainfall conditions have been tabulated and analyzed with respect to Passaic River water quality under the same conditions.

7. The overflow condition has been analyzed with respect to flow conditions during seasonal wet weather (high water table) periods in order to evaluate the implication of successful future cost-effective rehabilitation programs, insofar as frequency and magnitude of overflows are concerned.

8. Recommendations and costs have been developed as to proposed action regarding overflows based on:
   a) increased capacity of sewers
   b) storage
   c) treatment
   d) separation.

ARRANGEMENT OF REPORT

The detailed report upon overflows is divided into five parts. The first part consists of introductory remarks and contains the background information relevant to the inception of this study, followed by a general discussion of the procedures followed during the overflow chamber field surveys and inspections, the rationale behind the operation of the selected flow measuring and sampling equipment, and a brief description of how a typical overflow operates.

The other four parts are arranged according to the geographical location of the seventy-three overflows along the PVSC Interceptor from its northern terminus in the Paterson area to its southern terminus in the Newark area, as follows:

Paterson Area Overflows
Clifton-Passaic-Rutherford Area Overflows
Newark Area Overflows
Kearny-Harrison-East Newark Area Overflows

These area reports generally include the following features: some introductory comments on the size and extent of the collection areas, and the seasonal dry weather flows associated with each area; estimates of the amount of overflow based on rainfalls of varying amounts and duration; and observations on the capacity of the PVSC Interceptor in its various reaches, in relation to overflow estimates. In addition, findings are presented concerning rainfall intensities producing overflows, and the peak overflow rates and volume of overflow

discharge associated with the overflows in each of these four geographical areas. Appropriate summary tables and plates depicting the overflow locations are also included.

Information is also presented on City-owned overflows, which are above and beyond the PVSC overflows along the main interceptor and its branches, and the importance of including a study of the effect of these overflows upon the Passaic River, in addition to the PVSC Overflows, in future investigations.

Some conclusions concerning the significance of overflow and preliminary estimates of cost of separation of combined sewers in each of these geographical areas are also included. A brief description and analysis of the individual overflows in each of these four geographical areas are also included, following the introductory and general information outlined above.

Following these reports are separate sections discussing estimates of total system overflows, as well as estimates of total pollutional load contributions.

The Appendix contains seventy-three individual overflow extract reports, bound together by geographical area. Each extract contains observations which are unique to the particular location, a series of plates and tables depicting representative flow metering (where applicable), and sampling results obtained during the course of recorded observations at each chamber.

These reports are presented in varying format, as follows:

The Ivy Street, Kearny, overflow report was developed in full narrative style. The other reports were presented in "Data Extract" format, whereby the arrangement of the data follows the development in the comprehensive Ivy Street report, but in "short-hand" or "question and answer" format, to facilitate data presentation. Where warranted, extensive plates were prepared depicting water quality and pollutional loading observations in the latter half of the overflow data extract reports.

The Appendix also contains an overflow chamber cross-reference list of the bench-marks used for establishing elevations at each respective overflow chamber, and a Summary of Overflow Valve Closing Actions.

Overall conclusions and recommendations are contained in the "Summary Report upon Overflows into the Passaic River."

OVERFLOW STUDY AREA REPORTS

This section includes the summary of Overflow findings for four Study Areas composed of portions of eleven municipalities. For purposes of reporting, the results are presented for each of the 73 overflow chambers grouped into four geographical regions within the Passaic Valley Sewerage Commissioners Service Area. Because of the extent of the individual overflow studies the findings are presented herein with the detailed overflow data extract reports included as separately bound volumes.

INTRODUCTION

Work began with the inspection of the PVSC system, with cooperation and assistance of line crews of the Passaic Valley Sewerage Commissioners. Information (record of plans, etc.) relating to the overflows were made available by the Passaic Valley Sewerage Commissioners. Other pertinent data were requested and made available by the PVSC and member municipalities, such as siphon details (under the Passaic River), plans, profiles, and details of various sections of the PVSC trunk line, as well as flow records.

After review and analysis of the available records, location surveys were undertaken at each of the regulator chambers. The survey verified information such as sewer sizes, manhole rim elevations, and sewer invert elevations, outfall discharge locations (at the river), flow direction, lengths of lines, and other pertinent information. The condition of the outfall at each overflow was also noted (see overflow reports) and recorded.

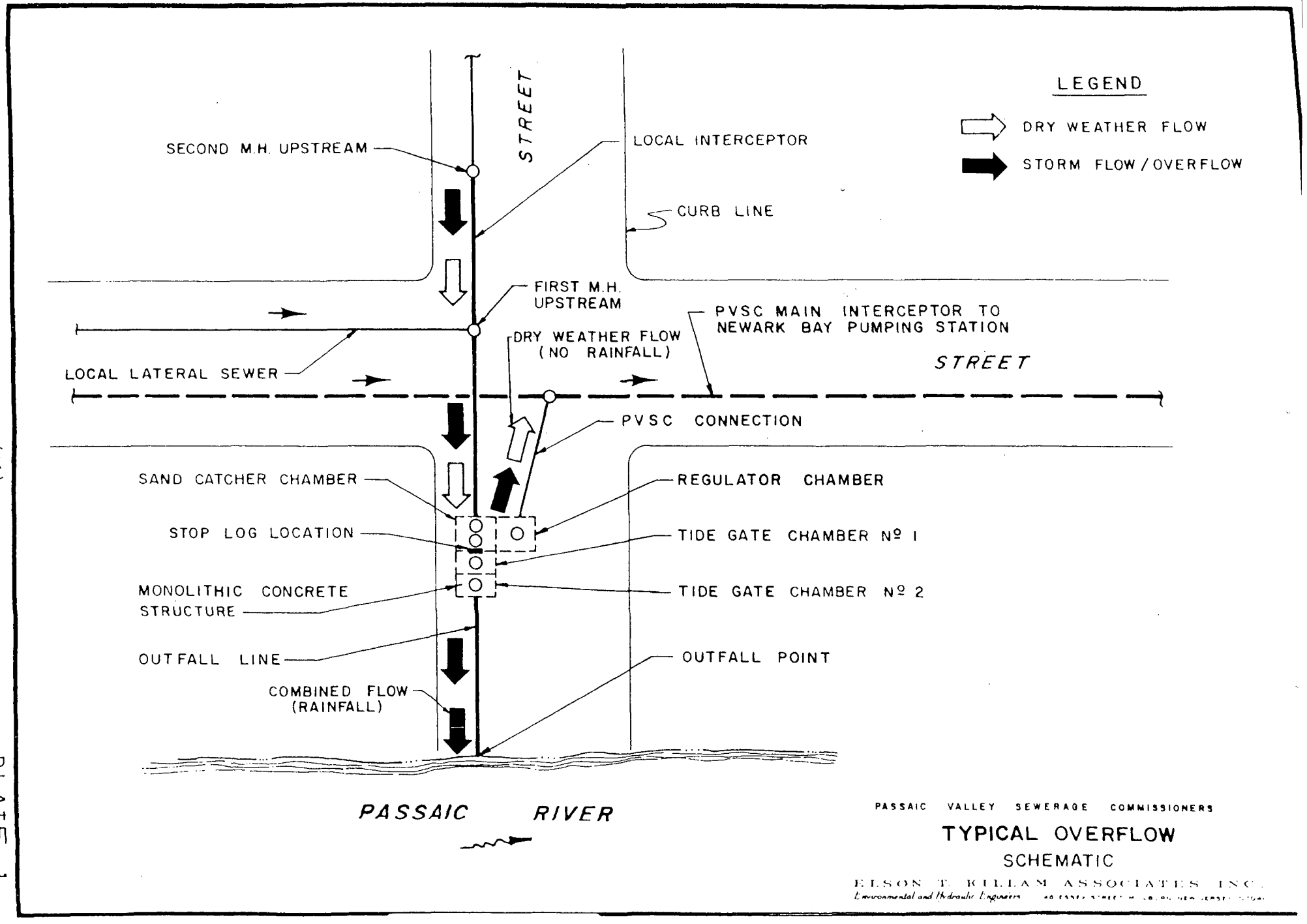
Additionally, tide gates, if any, were inspected from the point of view of condition and workability, as well as observation of possible tidal water inflow into the chambers during high tide conditions. These observations were made during high tide conditions, where applicable. Data was gathered to provide information for the verification of existing conditions and to provide the background to evaluate the effect of various alternatives (conclusions and recommendations).

Recording rain gauges were installed at the Passaic Valley Sewerage Commissioners' maintenance yard in Paterson, and additionally at the Wallington Pumping Station, and other locations in the service area. Storm observations made during the study period were used to determine rainfall intensity and duration. Visual observations were recorded as to the total general effect of the various storms, as an overview of conditions during various rainfall intensities and their apparent effect on the entire system.

A recording tide gauge was installed at the Saybrook Place overflow in Newark. The instrument was installed to obtain an accurate record of tidal variations in the study area. This information was subsequently used to determine tidal effect on the overflow outfall and tide gates.

A typical overflow schematic diagram for the type of overflow employed in the PVSC system is shown on Plate 1. A small pipe diverts a part of the flow into a regulator chamber, activating a float which closes or throttles a gate or opening to the PVSC trunk. Some regulators have a manual flap valve which may be closed, diverting all flow to the river.

Under normal conditions, during high storm flows, the float actuates the regulator, diverting all or part of the combined flow through an outfall line to the river, provided that the regulator is functioning. Under normal dry weather conditions, the sanitary flow enters the PVSC trunk after diversion through the regulator.



PASSAIC VALLEY SEWERAGE COMMISSIONERS

TYPICAL OVERFLOW SCHEMATIC

ELSON T. KILLAM ASSOCIATES INC.
Environmental and Hydraulic Engineers

(14)

PLATE 1

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A plan and profile drawing of each Active overflow chamber is included in the individual report for each overflow station, showing gradient conditions upstream and downstream of the chambers. The profile indicates ground elevations, manhole rim elevations, pipe inverts, outfall elevations, as well as pipe material, sizes, shapes, lengths, and slopes of all lines. The overflow drawing for the Inactive overflows usually consists of Plan view information only, since flow metering was not required at these locations. Storm sampling was performed at the Inactive overflow locations as required. Under normal conditions, all flow from the local interceptor totally enters the PVSC interceptor at the Inactive locations. No overflow is diverted to Passaic River at these locations, except during emergencies.

A master Overflow Inspection Summary is presented in Table 1, summarizing pertinent recorded observations concerning the condition of the regulator, the stop planks, the tide gates, the outfall lines, etc.

Flow measuring and sampling equipment was utilized during the study, consisting of a liquid level recorder, as well as an automatic composite sampler. The meters were installed at all active overflow locations. An active overflow is defined as one which operates automatically or by manual operation to relieve an overflow condition. An inactive overflow is one that, generally, has been taken out of service, either by closure of a gate, or by an installed plug.

TABLE 1

OVERFLOW INSPECTION SUMMARY

NPDES Nº	DESCRIPTION OF CHAMBER LOCATION	OVERFLOW		DIVERSION CHAMBER PRESENT	REGULATOR			SAND CATCHER					TIDE GATE #1			TIDE GATE #2			OUTFALL				SURCHARGE CONDITION OCCURS	TIDAL INFLOW NOTED	REMARKS
		ACTIVE	INACTIVE		OPERABLE	INOPERABLE	REMOVED	STOP LOGS IN PLACE	FLAP VALVE OPERABLE	FLAP VALVE INOPERABLE	FLAP VALVE MISSING	FILLED WITH DEBRIS	OPERABLE	LEAKING	MISSING	OPERABLE	LEAKING	MISSING	LOCATED	NOT LOCATED	PLUGGED	CLEAR			
	KEARNY-HARRISON AREA:																								
008/E-001	Central Ave., E. Newark	x				x		x			x			x				x	x			x	x	x	Surcharge observed @ 4.3' above stop log
010/H-001	New (Hamilton) St., Harrison	x				x		x		x				x			x		x			x	x	x	Surcharge observed @ 2.5' above stop log
011/H-002	Cleveland Ave., Harrison	x				x		x		x				x			x		x			x	x	x	Surcharge observed @ 4.8' above stop log
012/H-003	Harrison Ave., Harrison	x				x		x			x			x			x		x			x	x		Surcharge observed @ 1.5' above stop log T.G. #2 covered when building was built;
013/H-004	Dey St., Harrison	x				x		x		x				x				x	x			x	x	x	Surcharge observed @ 2.5' above stop log
014/H-005	Middlesex St., Harrison	x				x		x	x					x			x		x			x	x	x	Surcharge observed @ 1.6' above stop log
015/H-006	Bergen St., Harrison	x				x		x			x			x				x	x			x	x	x	Tide Gate # 2 is broken off & stuck in Tide Gate Chamber: Surcharge @ 2.7' above stop log
016/H-007	Worthington Ave., Harr.	x				x		x	x					x			x		x		x				Outfall partially plugged
019/K-008	Bergen Ave., Kearny	x				x		x			x		---------- NONE ----------						x			x			
020/K-004	Nairn Ave., Kearny	x		x		x		x			x		Single Chamber						x			x	x		Surcharge observed @ 4.7' above stop log
021/K-005	Marshall St., Kearny	x				x		x		x				x			x		x			x	x	x	Surcharge observed @ 3.0' above stop log
022/K-006	Johnston Ave., Kearny	x				x		x		**	x			x			x		x			x	x	x	Surcharge observed @ 3.7' above stop log
023/K-007	Ivy St., Kearny	x		x	x			x	---- NONE ----						x			x	x			x	x		Surcharge observed @ 5.8' above stop log
024/K-008	Bergen Ave., Kearny	x				x		NONE		x					x			x		x		x	x		Actual location where line empties into Frank's Creek not established; Surcharge @6.6' above S.L.
025/K-009	Tappan St., Kearny	x				x		NONE			x				x			x	x			x	x		Single regulator for both locations
026/K-010	Dukes St., Kearny	x				x		NONE			x				x			x	x			x	x		Outfalls join to one common pipe before emptying into Frank's Creek (surcharge @ 5.7' above S.L.)
	NEWARK AREA:																								
028/N-001	Verona Ave., Newark	x		x		x		x	---- NONE ----	**			x				x		x			x	x	x	Stop logs located in Diversion Chamber (dam) Surcharge observed @ 1.2' above stop log
029/N-002	Delavan Ave., Newark	x		x			x	x	---- NONE ----	**			---------- NONE ----------						x			x			Stop logs (brick wall) located in Diversion Chamber
030/N-003	Herbert Pl., Newark	x		x				x	x				---------- NONE ----------						x			x			
031/N-004	Third Ave., Newark	x				x		x	x				x				x		x			x			

[illegible] PRESENT IN CHAMBER.

S.L. = Stop Log M.H. = Manhole
T.G. = Tide Gate

TABLE 1

OVERFLOW INSPECTION SUMMARY

NPDES Nº	DESCRIPTION OF CHAMBER LOCATION	OVERFLOW		DIVERSION CHAMBER PRESENT	REGULATOR			SAND CATCHER						TIDE GATE #1			TIDE GATE #2			OUTFALL				SURCHARGE CONDITION OCCURS	TIDAL INFLOW NOTED	REMARKS
		ACTIVE	INACTIVE		OPERABLE	INOPERABLE	REMOVED	STOP LOGS IN PLACE	FLAP VALVE OPERABLE	FLAP VALVE INOPERABLE	FLAP VALVE MISSING	FILLED WITH DEBRIS		OPERABLE	LEAKING	MISSING	OPERABLE	LEAKING	MISSING	LOCATED	NOT LOCATED	PLUGGED	CLEAR			
032/N-005	Fourth Ave., Newark	x				x		x	x	**				x					x	x			x	x		Surcharge observed @ 5.9' above stop log. There are a total of 6 Tide Gates
033/N-006	Clay St., Newark	x		x		MANUAL		x		NONE				x	hung	open	x	on	step	x			x	x		Surcharge observed @ 6.1' above stop log. Sand Catcher half full of epoxy-like substance
033/N-006C	Passaic St., Newark	x				x		x		x		x				x		x		x			x	x	x	Surcharge observed @ 2.5' above stop log
034/N-007	Orange St., Newark	x				x		x	x							NONE				x			x			
035/N-008	Bridge St., Newark	x				x		x		x						NONE				x			x			
036/N-009	Rector St., Newark	x				x		x	x						x			x		x			x		x	
037/N-010	Saybrook Pl., Newark	x			MANUAL			x	BROKEN OFF **						x			x		x			x		x	
038/N-011	City Dock, Newark	x				x		x		NONE					x			x		x			x	x	x	No Sand Catcher at this location. Surcharge observed @ 2.4' above stop log
039/N-012	Jackson St., Newark	x				x		x	x						x			x		x			x	x	x	Surcharge observed @ 2.5' above stop log
040/N-013	Polk St., Newark	x				x		x	x						x			x		x			x	x	x	Surcharge observed @ 4.0' above stop log
041/N-014	Freeman St., Newark	x				x		x	x						x			x		x			x	x	x	Surcharge observed @ 3.2' above stop log
074/U-001	Union Outlet, Newark	x			MANUAL			NONE	MANUAL GATE							NONE				x			x			
KEARNY-NORTH ARLINGTON BRANCH:																										
017/K-002	Washington Ave., Kearny	x				x		x	x							NONE				x			x			
018/K-001	Stewart Ave., Kearny	x				x		x	x	**						NONE				x		x				Outfall partially plugged
071/R-001	Woodward Ave., Ruth.		x	x	NONE			NONE		NONE **				x			x			x		x				
072/R-002	Pierrepont Ave., Ruth.	x		x	NONE			NONE		NONE **					x			x		x			x		x	
073/R-003	Rutherford Ave., Ruth.	x		x	NONE			x		NONE **				x			x			x			x			Stop logs (brick dam) located in Diversion Chamber.
003	Yantacaw St., Clifton		x		NONE			NONE		NONE **						NONE				x			x			Manual slide gate controls overflow
004	Yantacaw P.S., Clifton North Arlington Overflow Chamber, N. Arlington		x		NONE			NONE		NONE **				x			x			x			x			Manual slide gate controls overflow
006			x		NONE			NONE		NONE **					x			x			x	x			x	Outfall covered with debris

** NO FLAP VALVE PRESENT IN CHAMBER

S.L. = Stop Log M.H. = Manhole
T.G. = Tide Gate

TABLE 1

OVERFLOW INSPECTION SUMMARY

NPDES Nº	DESCRIPTION OF CHAMBER LOCATION	OVERFLOW		DIVERSION CHAMBER PRESENT	REGULATOR			SAND CATCHER						TIDE GATE #1			TIDE GATE #2			OUTFALL				SURCHARGE CONDITION OCCURS	TIDAL INFLOW NOTED	REMARKS
		ACTIVE	INACTIVE		OPERABLE	INOPERABLE	REMOVED	STOP LOGS IN PLACE	FLAP VALVE OPERABLE	FLAP VALVE INOPERABLE	FLAP VALVE MISSING	FILLED WITH DEBRIS		OPERABLE	LEAKING	MISSING	OPERABLE	LEAKING	MISSING	LOCATED	NOT LOCATED	PLUGGED	CLEAR			
GARFIELD-WALLINGTON-PASSAIC BRANCH:																										
027/L-001	Lodi Force Main, Wall.		x			NONE		NONE		NONE							NONE			x			x			24" Gate Valve on overflow line
069/Q-001	Passaic Tail Race, Pass.		x			NONE		NONE		NONE							NONE			x			x			Manual slide gate controls overflow
070/Q-002	Dundee Island, Passaic	x				NONE		NONE		NONE							NONE				x	x				8 in. outfall line plugged-actual outfall point never located-must be covered with debris
009/G-001	Garden State Paper Company, Garfield		x			NONE		NONE		NONE							NONE			x						Manually operated bypass overflow
005	Wallington P.S., Passaic		x			NONE		NONE		NONE							NONE			x			x			Manual slide gate controls overflow
	PATERSON AREA:																									
064/P-023	Second Ave., Paterson	x				x		x	x					x			x			x			x	x		The outlet of T.G. Chamber #2 is controlled by a 2nd set of stop planks which are set at a higher elevation than those in Str. Catcher. Surcharge has been observed at approx. 2' from M.H. Rims.
065/P-024	Third Ave., Paterson	x				x		x	x					x			x			x			x	x		
066/P-025	Tenth Ave., Paterson	x				x		x	x					x			x			x			x			
067/P-026	Twentieth Ave., Paterson	x				x		x		x **				x			x			x			x			
068/P-027	Market St., Paterson	x		x		x		x		NONE						NONE				x			x			Stop logs located in Diversion Chamber
042/P-001	Curtis Pl., Paterson	x			x			x	x							NONE				x			x			
043/P-002	Mulberry St., Paterson	x				x		x	x					x			x			x			x	x		Surcharge observed at M.H. Rim elevation
044/P-003	W.Broadway, Paterson	x				x		x	x					x			x			x			x	x		Surcharge observed at M.H. Rim elevation Outfall covered with debris.
045/P-004	Bank St., Paterson	x				x		x		x				x			x				x	x		x		Surcharge observed @ M.H. Rim elevation
046/P-005	Bridge St., Paterson	x				x		x	x					x			x			x			x	x		Surcharge observed @2.0'below Rim elevation
047/P-006	Montgomery St., Paterson	x				x		x	x					x			x			x			x	x		Surcharge observed @ M.H. Rim elevation
048/P-007	Straight St., Paterson	x				x		x	x					x			x			x			x	x		Surcharge observed @3.2'above stop log
049/P-008	Franklin St., Paterson	x				x		x	x					x			x				x	x		x		Outfall so low that it is covered with river silt. Surcharge observed @3.0' above stop log
050/P-009	Keen St., Paterson	x				x		x		x				x			x			x			x	x		Surcharge observed @7' above stop log
051/P-010	Warren St., Paterson	x					x	x	x					x			x			x			x	x		Surcharge observed @5' above stop log Outfall partially blocked with river material
052/P-011	Sixth Ave., Paterson	x				x		x			x			x			x			x		x		x		Surcharge observed @5' above stop log

** NO FLAP VALVE PRESENT IN CHAMBER

S.L. = Stop Log M.H. = Manhole
T.G. = Tide Gate

OVERFLOW INSPECTION SUMMARY

NPDES Nº	DESCRIPTION OF CHAMBER LOCATION	OVERFLOW		DIVERSION CHAMBER PRESENT	REGULATOR			SAND CATCHER					TIDE GATE #1			TIDE GATE #2			OUTFALL				SURCHARGE CONDITION OCCURS	TIDAL INFLOW NOTED	REMARKS
		ACTIVE	INACTIVE		OPERABLE	INOPERABLE	REMOVED	STOP LOGS IN PLACE	FLAP VALVE OPERABLE	FLAP VALVE INOPERABLE	FLAP VALVE MISSING	FILLED WITH DEBRIS	OPERABLE	LEAKING	MISSING	OPERABLE	LEAKING	MISSING	LOCATED	NOT LOCATED	PLUGGED	CLEAR			
053/P-012	East Fifth St.,Paterson	x		x		x		x		x			x			x			x			x	x		Stop logs located in Tide Gate Chamber
054/P-013	East Eleventh St.,Pat.	x				x		x			x		x			x			x			x			
055/P-014	East Twelfth St.,Pat.	x				x		x	x				NONE						x			x			
056/P-015	S.U.M. Park, Paterson	x					x	x	x				NONE						x			x			Outfall was opened up on cave-in
057/P-016	North West St.,Pat.	x			---	NONE	---	x	x				x			x			x			x	x		Surcharge observed @ 2.5' below Rim elevation
058/P-017	Arch St.,Paterson	x			---	NONE	---	x	x				x			x			x			x	x		Surcharge observed at Rim elevation
059/P-018	Jefferson St.,Paterson	x			---	NONE	---	NONE		x			x			x				x	x		x			Sand Catcher outlet to T.G. Chambers plugged with masonry plug. Outfall covered with debris
060/P-019	Stout St.,Paterson	x			---	NONE	---	NONE		x			BOTH TIDE GATES BROKEN							x	x		x			Sand Catcher outlet to T.G. Chambers plugged with masonry plug. Outfall covered with debris
061/P-020	N.Straight St.,Pat.	x			---	NONE	---	NONE		x					x			x	x			x	x			Sand Catcher outlet to T.G. Chambers plugged with masonry plug. T.G. 1&2 have been removed
062/P-021	Bergan St.,Paterson	x			---	NONE	---	x	x				x			x			x			x	x		Surcharge observed @2.6' above stop log
063/P-022	Short St.,Paterson	x			---	NONE	---	x	x	**			x			x			x			x	x		
007	Hudson St.,Paterson	x				x		x		NONE			x			x			x			x	x		Surcharge observed @ Rim elevation

** NO FLAP VALVE PRESENT IN CHAMBER

S.L. = Stop Log M.H. = Manhole
T.G. = Tide Gate

946570058

Sampling equipment consisted of an automatic type, battery-operated unit, equipped with a vacuum pump to obtain discrete 500-milliliter samples over a pre-set time cycle (one composite sample every fifteen minutes), up to 24 composite samples per cycle. Samplers were installed at all overflow locations, Active and Inactive. The results of sampling may be found in the Appendix to each individual overflow report.

Liquid level recorders were installed in the Active overflow chambers, with the level-sensing probe for each device positioned at the elevation of the crest of the stop logs (or diversion dams). Where stop logs or planks were removed, the meter probe was set at the level of the invert of the opening to the outfall (above normal flow levels).

When the level of flow in the overflow chamber rises above the level of the stop logs, overflow to the river occurs. Meter readings were obtained whenever the flow reached the stop logs. When the outfall was surcharged, flows were approximated using alternative hydraulic analysis (i.e., orifice flow, etc.).

Additionally, special surcharge devices, called "surcharge sticks" were installed in the overflow chambers, in order to define peak overflow conditions. These devices, protected wooden shafts, coated with a special paint, are enclosed in a length of plastic pipe, open at the bottom to admit the flow. These were installed vertically in the manhole or overflow chamber to determine high water marks during actual surcharge, or high water conditions. The high water condition left

visible marks on the painted stick surface inside the protective pipe section, recording a peak flow level during the surcharge conditions.

Sampling of water quality was achieved either automatically in each chamber, or manually where necessary, with a remote sampler start probe set at the crest elevation of the overflow stop planks or dam. Discrete storm samples were obtained automatically, when the flow level exceeded the stop plank/dam elevation, at 15-minute sampling intervals, throughout the course of rainfall occurrence producing an overflow. The samples were analyzed at the laboratories of the Passaic Valley Sewerage Commissioners for Total Suspended Solids (TSS), Chemical Oxygen Demand (COD), and Biochemical Oxygen Demand (BOD), as well as for other parameters. Results of the analysis are included in the Appendix to each report. The results of a typical analysis for a rainfall occurrence of representative significance are also included in the Appendix of each overflow report.

In numerous instances, simultaneous metering and sampling were obtained at one or more times during the course of the study, at particular overflows. Graphical presentations in each overflow report depict such simultaneous results. In other instances, it was not possible to obtain a simultaneous correlation of metering and sampling information in every instance. This situation is predicated on the following: vagaries of the weather, time constraints of this study, and the situation where valid sampling results may have been obtained, but no corresponding simultaneous metering results were obtained due to various causes. These causes in turn may have been due to the interference of tidal intrusions in the

overflow chamber, creating a standing surcharge condition at the metering location which is not truly indicative of a "freeboard" overflow condition, the absence of sufficient overflow level to produce a meter reading. possible meter malfunctions, etc. In other cases, valid metering results were obtained, but no corresponding simultaneous sampling results were obtained, again due to sampler malfunctions, etc.

Where it was not possible to obtain simultaneous metering and sampling, a composite package of data was assembled as a graphical presentation in the respective overflow reports. This composite package of data was developed by utilizing metering information from a particular rainfall occurrence, coupled with sampling results from an overflow due to a comparable rainfall. The comparability of the rainfall was based on such factors as total amount of rainfall, duration, overall intensity, etc.

Metering charts which registered as blank during rainfall conditions were obtained in some instances and bore out the absence of an overflow occurrence. This absence of an overflow condition was also verified by actual visual field observation, at times, throughout the study period. For these locations, no flow metering results could be obtained; hence, no data is presented on pollutional loading rates or total pollutional loads discharged to the Passaic River. Samples of combined flow were obtained during rainfall conditions (although no overflow occurred). The sample analyses are presented graphically in the applicable overflow reports as a background condition.

Included in the Extract Report appendices is a plot of overflow rates versus time (levels over the stop plank). The average overflow rate (Million Gallons per Day, MGD) and total volume of overflow (Millions of Gallons, MG) are also shown for each overflow. The corresponding hourly rainfall intensity is also shown, plotted against time. The graphical data for a particular overflow also includes a calibration curve, relating height of flow over stop logs or dam to overflow rates at each location, as well as a plot of the Passaic River tidal levels (at the outfall) during the time of the rainfall, referenced to the stop log elevations.

In some cases, overflow conditions are modified due to tidal levels causing a closure of the tide gates, preventing active free overflow conditions, and causing chamber surcharging. In other cases, particularly in the Paterson area, meter readings (which were activated due to surcharge of the PVSC trunk or branch interceptor) were discounted, because a "free" overflow condition did not exist.

Where repeated surcharge conditions were encountered and samplers were inundated, it was necessary during those rainfall conditions to place samplers on ground level at certain locations to manually activate the sampling cycle.

The graphic presentation of pollutional loading (where applicable) contained in each overflow report represents values derived from either simultaneous metering and sampling results, or favorable composite metering and sampling, resulting from two rainfalls of similar characteristics.

Samples so obtained have been compared to those collected over one 24-hour period, for the tributary sewage flow from the local interceptor at each chamber (Active and Inactive) during non-rainfall conditions, to serve as a baseline of sample values. These samples were analyzed at the PVSC Laboratories for the required parameters. The results have been presented in tabular form for each overflow (see Appendices). This baseline analysis defines the water quality during periods of non-rainfall.

A detailed report upon overflow for each of the major geographical areas along the PVSC interceptor system follows.

REPORT UPON

OVERFLOW ANALYSIS

TO

PASSAIC VALLEY SEWERAGE COMMISSIONERS

PASSAIC RIVER OVERFLOWS

PATERSON AREA

1976

ELSON T. KILLAM ASSOCIATES, INC.
Environmental and Hydraulic Engineers
40 ESSEX STREET MILLBURN, NEW JERSEY 07041

PATERSON AREA OVERFLOWS

Extent of Area and Peak Overflow Rates

Twenty-eight active overflows were studied and observed in the City of Paterson area. No inactive overflows were observed in this reach of the Passaic River, which extends a distance of approximately six miles. The twenty-eight active overflows serve a total tributary area of 5,100 acres, all of which are served by combined sanitary and storm sewer systems. The majority of these overflows is activated at such times that the combined sewer systems, tributary to these chambers, are under storm flow conditions when rainfall occurs. All of the operable overflows are activated automatically in the Paterson area.

The aggregate capacity of the combined sewer systems is about 2,520 MGD, which is approximately 0.5 cubic feet per second (cfs) per acre of drainage area. This is somewhat below the conventional design for small drainage areas, which normally ranges from about 1.0 cfs to 1.5 cfs per acre. Under periods of heavy rainfall in the City of Paterson, the existing combined sewer system cannot accommodate the storm water inflow, with the result that surcharge of piping and flooding of streets occur when catch basins and combined sewer sizes are inadequate.

The measured average daily dry weather flow in the combined sewer system of the Paterson area, which includes sanitary sewage from separate systems that are connected with the City of Paterson sewer system, or which discharge directly into the PVSC interceptor sewer, is about 51 Million Gallons per Day (MGD) during dry weather months. This compares with a theoretically determined dry weather flow of 35 MGD.

During wet weather months, when the ground water table is high, the average daily dry weather flow (when no rainfall occurs) was found to be about 64 MGD. Ground water infiltration is approximately 29 MGD in the City of Paterson system during a period of approximately seven to eight months of each year, and 16 MGD during dry weather months. This infiltration is attributed to the characteristics of the combined sewer system, which was constructed many decades ago, presumably so as to permit ground water entry into the pipelines. Therefore, the removal of infiltration in a combined sewer system may be found to be both difficult and costly, as well as ineffective.

The total estimated length of combined sewers in the Paterson area is approximately 155 miles, or about 820,000 linear feet. It has been estimated that the cost of construction to provide a separate sanitary sewer system for the City of Paterson would be approximately $185 million. Under such a separation plan, it has been assumed that the existing combined sewer pipelines would be severed from the sanitary sewer lines and that the old combined sewers would be utilized as a separate storm sewer system. In order to effect a meaningful reduction in the infiltration through complete system separation, it would also be necessary to install new house connections, extending at least from the street to the property line, if not all the way to and into the building structures, to assure that old-type building drainage systems with built-in ground water infiltration will have been eliminated from the collection system.

The twenty-eight overflow chambers are served by drainage

areas ranging in size from as small as two to four acres to as large as 1,487 acres. The aggregate capacity of the combined storm sewer pipelines, which serve these tributary areas, has been estimated to be about 2,500 MGD. This is equivalent to about 50 times the average daily dry weather flow of about 50 MGD. The estimated aggregate capacity of the overflow pipes from the chambers to the river has been estimated to be about 1,800 MGD. This is equivalent to about 36 times the average daily dry weather flow (essentially sanitary and industrial wastes) in the system. In other words, under conditions of a heavy rainfall or severe storm, where the storm water runoff would inundate and surcharge the entire collection system, a flow of 2,500 MGD, or more, could conceivably enter the twenty-eight overflow chambers, with the probability of a discharge into the river of at least 1,800 MGD, but conceivably more under surcharge conditions and, of course, this could approach the 2,500 MGD capacity of the incoming lines to these overflow chambers. The overflow into the Passaic River is reflective of the combined sewer flow which cannot be carried by the PVSC interceptor sewer.

It will be noted that the interceptor sewer in the City of Paterson at the upper terminus of the collection system has a capacity of only 21 MGD and, at the point of discharge from the City of Paterson, the capacity of this interceptor sewer is only about 82 MGD. It is obvious from the above that the PVSC interceptor sewer cannot accommodate the maximum storm flow rates which occur under severe rainfall conditions in the combined sewer system of Paterson.

Table 2, which is entitled "Tabulation of Passaic Valley Sewerage Commissioners' Overflows in the City of Paterson Area," sets forth a tabulation of each overflow, the tributary area to the overflow, the measured dry weather flow under seasonal conditions, the estimated capacity of the storm sewers tributary to these areas, the estimated overflow capacity from these chambers to the river and, finally, the observed or recorded peak flow rates and volume of discharge into the Passaic River.

Overflow Estimates Based on Rainfall

A study has been made of the theoretical volume and peak flow rate of discharge from the overflows in the Paterson collection system based upon rainfalls of various intensities and durations.

A total rainfall of approximately one inch results in a total volume of water accumulation of approximately 138 MG of storm water over the 5,100 acres. With the drainage area known, and giving due consideration to controlling factors such as rainfall concentration, runoff, number and location of catch basins, storm sewer efficiency, impervious areas, and other relevant factors, the storm water runoff or entry into the collection system can be estimated.

It has been estimated that only twenty of the twenty-eight overflow stations will respond to a rainfall of one inch occurring in a 24-hour period, or at an intensity of 0.04 inches per hour.

Of the portion of rainfall which is intercepted by the combined sewer system (50 to 60 percent), it has been estimated that about 52 to 66 MG will be discharged from the overflow chambers and the balance

TABLE 2

TABULATION OF IVSC OVERFLOWS IN CITY OF PATERSON AREA

Overflow Location	Discharge Permit Number	Tributary Area (Acres)	% of Area with Combined Sewers	DRY WEATHER FLOW		Estimated Maximum Storm Capacity (MGD)	Estimated Maximum Overflow Capacity to River (MGD)	Maximum Peak Recorded Overflow to River (MGD)	Maximum Overflow Observed (MG)
				Dry Weather Months (MGD)	Wet Weather Months (MGD)				
Curtis Place	042/P-001	965	100	7.85	9.35	285.0	175.0	17[illegible].0	1.3
S.U.M. Park	056/P-015	46	100	0.12	0.28	18.6	18.6	19.5	[illegible]
Mulberry Street	043/P-002	4	100	Neg.	Neg.	22.5	13.0	9.7	0.9
West Broadway	044/P-003	4	100	0.07	0.11	5.1	4.0	7.8	0.4
Bank Street	045/P-004	4	100	Neg.	Neg.	6.5	8.7	---	---
Bridge Street	046/P-005	63	100	0.17	0.33	185.3	57.1	39.5	0.2
Northwest Street	057/P-016	(283)	100	(2.00)	(3.00)	303.6	574.0	90.0	5.5
Arch Street	058/P-017	(32)	100	(0.15)	(0.17)	6.7	6.7	15.0	0.6
Jefferson Street	059/P-018	(38)	100	(0.18)	(0.20)	10.0	---(4)	---	---
Stout Street	060/P-019	(15)	100	(0.08)	(0.08)	10.5	---(4)	---	---
North Straight St.	061/P-020	(82)	100	(0.39)	(0.43)	35.0	26.0	---	---
Hudson Street	007	450(3)	100	3.51(3)	4.42(3)	16.7	16.7	18.5	5.3
Montgomery Street	047/P-006	667	100	2.83	3.84	220.0	220.0	44.2	5.4
Straight Street	048/P-007	121	100	0.84	1.80	16.5	66.5	57.0	1.3
Franklin Street	049/P-008	2	100	Neg.	Neg.	4.2	7.6	---	---
Keen Street	050/P-009	11	100	0.33	0.69	7.6	10.3	18.8	0.6
Short Street	063/P-022	32	100	0.51(2)	0.86(2)	49.3	35.8	9.1	0.7
Bergan Street	062/P-021	11	100	0.07	0.18	4.2	15.5	6.4	1.9
Warren Street	051/P-010	81	100	1.40	1.88	60.0	9.7	11.1	1.2
Sixth Avenue	052/P-011	50	90	0.09	0.11	11.2	18.5	18.8	---
East 5th St. & 5th Ave.	053/P-012	10	100	0.13	0.13	5.9	6.5	11.5	0.4
East 11th St.	054/P-013	104	100	0.89	0.89	42.7	41.9	46.0	5.0
East 12th St. & 4th Ave.	055/P-014	19	100	0.27	0.28	57.0	57.0	12.5	0.2
Second Ave.	064/P-023	45	100	0.54	0.53	20.4	29.7	13.1	0.3
Third Avenue	065/P-024	73	100	0.75	0.60	29.7	60.0	20.8	0.7
10th Ave. & 33rd St.	066/P-025	699	100	5.34	6.70	389.0	113.0	91.5	6.6
20th Avenue	067/P-026	96	100	0.13	0.14	155.0	11.4	16.5	0.3
Market Street	068/P-027	1,487	100	13.60	16.20	540.0	223.3	93.0	14.8
Other Areas (tributary to interceptor)		56							
TOTAL		5,100		39.44	49.32	2518.2	1826.5	693.3	54.0

(1) [illegible]

(2) Includes 0.34 MGD from Prospect Park

(3) Hudson Street includes Northwest Street, Arch Street, Jefferson Street, Stout Street and North Straight Street

(4) Outfall plugged with debris and buried

would be conveyed downstream for treatment and disposal.

With a more intense rainfall, namely, a rainfall of about one inch in twelve hours, it has been estimated that approximately 60 to 75 MG will be discharged into the Passaic River, while the balance will be delivered through the interceptor sewer lines downstream for treatment and disposal.

Assuming that a 1-inch rainfall occurs in approximately six hours, which is a storm of higher intensity, namely, 0.17 inches per hour, it has been estimated that approximately twenty overflows will still be activated out of the total of twenty-eight. Under this storm condition, the overflow into the Passaic River would range from about 65 to 80 MG, and the balance of the estimated storm flow would be intercepted by the combined sewer system for treatment and disposal.

With an intense rainfall of one inch per hour, it has been estimated that most of the overflows will discharge in the Paterson area. The estimated overflow into the Passaic River under this type of storm flow condition will range from about 68 to 83 MG, with the balance conveyed downstream for treatment and disposal.

When a rainfall of two inches occurs and deposits 276 MG of water over the 5,100 acres (as contrasted to one inch as set forth above, under various time-duration conditions), and when the total storm water estimated to be handled by the collection system is from 138 to 166 MG, the following estimates have been made of overflow into the Passaic River:

Time Duration of 2-Inch Storm	Estimated Overflow
24 hours	120 MG to 150 MG
12 hours	130 MG to 157 MG
6 hours	134 MG to 162 MG
1 hour	137 MG to 165 MG

Overflow Measurements

During the period of study and observation of each of the twenty-eight overflow chambers, approximately forty to fifty rainfalls, or more, were observed. Depth-recording gauges were installed in twenty-five of the chambers (the outfall line for three of the chambers is bricked up) and measurements of overflow were made at each of these chambers for several of the rainfall occurrences throughout the period of study. By installing temporary continuous-depth measuring equipment in these overflow chambers, it has been possible to determine, generally, the extent and duration of overflows as related to rainfall. Likewise, by installing sampling equipment, it has been possible to obtain samples and to conduct tests of the overflow to determine the extent of pollution discharged into the receiving stream when these overflows occur.

The results of these studies and measurements indicate that the maximum overflow to the river from the twenty-eight chambers during this period of study was approximately 700 MGD. These overflow rates were found to be of short-term duration and do not reflect the volume of discharge into the river.

The volume of discharge from the twenty-eight overflows was determined to be about 54 million gallons (MG) during the period of study and observation.

It would appear from the results of this study that overflow occurs at approximately twenty overflows when the rainfall intensity approaches or exceeds 0.08 inches per hour. No overflow was observed or measured at seven overflow chambers, and it appears that these chambers can be eliminated without any detrimental effect upon the operation of the collection system, or in increasing the overflow discharge to the river.

In general, it was found in the Paterson area that, within a short period after the beginning of a rainfall of modest intensity, overflow occurred at most of the overflow chambers. This overflow would continue during the entire period of rainfall and would terminate shortly after or at about the same time as the rainfall would stop. Thus, the overflows are "rainfall-sensitive," and it can generally be stated that the overflows were of short-term duration, and were related directly to the time of duration and intensity of the rainfall.

The exception to the foregoing was the Market Street overflow which was initially found to be operative on occasions during peak daily dry weather flow conditions. This was attributed to the limited carrying capacity of the interceptor sewer in the Paterson area, but the overflow has been eliminated by raising the overflow weirs in this chamber.

Interceptor Capacity

The location of the interceptor sewer and the location of the twenty-eight overflow chambers along the Passaic River in the Paterson area are shown on Plate 2.

The interceptor sewer which is located in Paterson not only

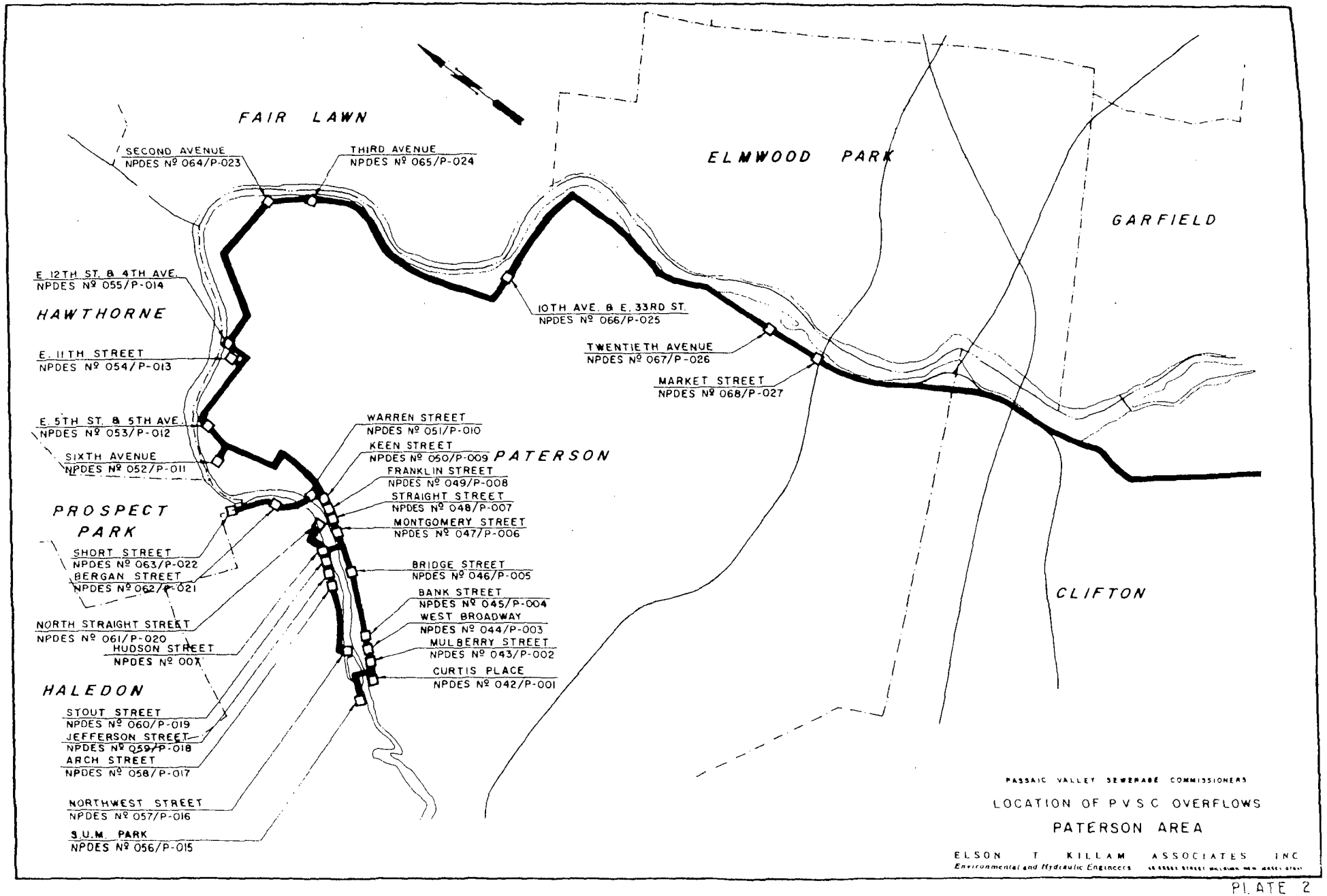

PLATE 2

(34)

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serves as an outlet for the City of Paterson, but also provides an outlet for Haledon, which has an average daily flow of about 1.0 MGD; for Prospect Park, which has an average daily flow of 0.3 MGD; for Hawthorne, which has an average daily flow of about 2.5 MGD; for Fairlawn Industries, which has an average daily flow of 0.26 MGD; for Glen Rock, which has an average daily flow of 1.0 MGD; for Fair Lawn, which has an average daily flow of about 2.1 MGD; and for Elmwood Park, which discharges an average daily flow of 2.3 MGD. In addition, Marcal Paper Company discharges approximately 3 to 4 MGD, and other industries contribute approximately 0.5 to 1 MGD, or a total flow from outside of the City limits of approximately 13.6 MGD.

It will be noted from Plate 2 that the interceptor sewer at the point of beginning in the upper reaches of the Passaic River in Paterson has a capacity of approximately 20.8 MGD, increasing to 35.9 MGD immediately downstream of the Lawrence Street connection, and thence this capacity increases to 39.9 MGD, to 46.4 MGD, and then increases to about 49.8 MGD at about the midpoint of the interceptor in the City at 10th Avenue and 33rd Street. Immediately downstream of 10th Avenue, the capacity is 57.0 MGD and it increases to 59.4 MGD south to Overlook Avenue. South of 20th Avenue, the capacity increases to 81.6 MGD. The point of metering at the Venturi is located near the City boundary line. The Venturi meter capacity is reported to be 76.0 MGD. When the Venturi capacity of 76.0 MGD is reached, surcharge occurs in the upstream portions of the interceptor sewer through the City of Paterson.

City of Paterson Overflows

The aggregate overflow to the Passaic River in the Paterson area under maximum storm flow conditions observed was somewhat less than anticipated. This can be attributed, in part, to the rainfall occurrences during the study period and the fact that about twenty-three other overflows are located within the City of Paterson system. These overflows discharge into the Passaic River, and the facilities are not a part of the PVSC system. Based upon the studies and observations, it is possible to make projections of what the total system overflow might be, under more severe rainfall conditions than those which were observed during the period of study.

The most important discovery made during this study period was that several major overflows located within the City of Paterson system are presently operative and discharge voluminous quantities of water directly into the Passaic River during periods of rainfall, and these facilities operate entirely independently of the Passaic Valley Sewerage Commissioners' system.

The most important and most critical City of Paterson overflow is located at the intersection of Nineteenth Avenue and Vreeland Avenue. From this point, a 90-inch diameter storm sewer, which extends from this intersection to the Passaic River, conveys the overflow from storms directly to the river. It has been estimated that this outlet pipe can carry a combined storm water flow of approximately 120 to 150 MGD. Observations made at this chamber indicate that this overflow is automatically activated at each and every rainfall, with intensities possibly

as low as 0.04 inches per hour. These overflows generally prevail during the entire rainfall period. It is suggested that a study be made of this overflow, in conjunction with the twenty-eight PVSC overflows, to establish not only quantity and quality but, more importantly, to determine how this overflow will be handled in connection with the improvements to be provided in the PVSC interceptor sewer system.

In addition to the foregoing major City of Paterson overflow facilities, it was found that nine other overflow chambers are located generally within the center of the City of Paterson and discharge into the storm sewer constructed primarily to serve as an outlet for these nine overflow chambers. The pipeline serving these nine chambers is 102 inches in diameter and extends from the nine chambers, which are located at Trenton Avenue at the intersections of Maryland Avenue, Florida Avenue, Illinois Avenue, Michigan Avenue, Twenty-Second Avenue, Twenty-Third Avenue, and Twenty-First Avenue, as well as at Maryland Avenue and Vernon Avenue. The estimated capacity of the outfall pipeline is 150 to 200 MGD. While detailed observations were not made at each of the nine overflow chambers during storm flow conditions, observations and reports from the field indicate that essentially all of these chambers overflow under modest rainfall conditions, namely, those with an intensity of about 0.05 inches per hour.

In addition to the foregoing, it has been indicated during the field interviews that the City of Paterson may have as many as thirteen or more additional overflows or interconnections within the City system which are frequently discharged through overflows during storm flows.

It is suggested that further investigations be conducted within the City of Paterson collection system to establish, insofar as possible, the locations of these interconnections, and to ascertain the effect of such overflow upon the Passaic River. This study should also provide for the means of correction which should be coordinated with the proposed PVSC improvements.

It is our opinion that the PVSC overflows which were observed and measured during storm flows at the twenty-eight overflow chambers represent possibly an amount equal to the total overflow occurring in the City of Paterson area from independent overflow chambers and pipelines hereinbefore constructed by the City of Paterson. In other words, in lieu of an overflow discharge during a storm of about 54 MG as observed, it is possible that the total system overflow may be twice this amount. It is suggested that studies be undertaken, as necessary, to verify the existence of all City-owned and operated overflows which must be considered in any plan of improvement undertaken for the elimination of pollution in the Passaic River.

Individual Overflow Chambers

A brief description and analysis of each of the existing overflows in the Paterson area are set forth on the following pages.

CURTIS PLACE OVERFLOW CHAMBER

This chamber serves a tributary area of approximately 965 acres, for which the collection system is combined sewers. The average daily flow tributary to this chamber was found to range seasonally from 7.85 MGD to 9.35 MGD. However, it must be stressed that this includes the dry weather flow from Haledon which was metered and found to range from approximately 1.0 MGD to 1.3 MGD. Thus, the net dry weather flow from the City of Paterson Combined Sewer District ranges from 6.8 MGD to 8.0 MGD, indicative of high infiltration in the area. The connection from Haledon passes through the City of Paterson combined sewer collection system before it reaches the overflow chamber.

Under storm flow conditions, when the combined sewer system is handling the storm water inflow, overflow occurs into a mill tail race near the overflow chamber which discharges into the Passaic River. Measurements and observations were made at this chamber beginning on December 7, 1974 and extending through June 13, 1975. During this period of time, 37 periods of rainfall occurred and overflows were observed or metered on 25 occasions.

It was observed that while overflows were frequent, the volume of discharge into the river was not very great. Measurements range from a low of only 0.1 million gallons to a high of 1.3 million gallons. Peak rates of flow were found to be about 20 MGD and occurred for short periods of time during the maximum intensity of rainfall. In addition, the City of Paterson has constructed storm sewers in portions of the

Curtis Place collection area. These storm sewers were constructed to alleviate flooding in the Hillcrest Section of the City and to serve as relief to the combined sewers discharging directly into the Passaic River. There are eight overflow connections to the storm sewers in the Curtis Place sewer district. These overflows are located on Crosby Avenue, Richmond Avenue, Linwood Avenue, and West Side Park.

Based on the foregoing results, it is estimated that an overflow will occur at the Curtis Place overflow chamber 50 to 60 times per year, based on rainfalls occurring 70 to 90 times per year.

The dry weather flow at the Curtis Place Chamber was sampled and the results indicated primarily domestic sewage combined with some industrial waste. The BOD was found to range from 120 mg/1 to 495 mg/1. The TSS was found to range from about 60 mg/1 to about 300 mg/1.

The quality of the overflow was determined as a result of many samplings at this station. The BOD was found to range from about 121 mg/1 to about 277 mg/1. The total suspended solids were found in some occasions to be very low but, in general, were in excess of 100 mg/1 and as high as 317 mg/1. The Curtis Place overflow chamber is not a major contributor to the pollution of the Passaic River, despite the relatively large drainage area served with combined sewers.

S.U.M. PARK OVERFLOW CHAMBER

This overflow chamber serves a tributary area of approximately 46 acres. The system consists of combined sewers. The average daily flow in this system was found to range seasonally from 0.12 MGD to 0.28 MGD.

Metering facilities were installed in this chamber and measurements of rainfall and overflows were made and observed during a period extending from May 30 to October 19, 1975. It will be noted that 13 rainfalls occurring during this period were observed and it has been estimated that overflows occurred on 5 occasions. Overflows occurred generally when the intensity exceeded 0.10 inches per hour.

It was found that the volume of overflow discharged into the river was very limited and ranged from about 0.1 to 0.5 million gallons. Peak rates of overflow were found to be as high as 50 MGD.

This low overflow volume is attributed to the fact that a very small tributary area is served by this combined sewer system, the pipe size of which is only 36 inches in diameter. The S.U.M. Park overflow chamber is the uppermost facility located on a branch interceptor sewer and is the most upstream overflow discharging into the Passaic River.

Based on the foregoing, it is estimated that this overflow chamber will be activated 25 to 35 times per year based on rainfalls occurring 70 to 90 times per year.

Samples at the overflow were taken under dry weather conditions and the results indicated typical domestic sewage. The TSS concentration averaged 250 mg/1 and the BOD concentration averaged 106 mg/1.

A comparison of the dry weather sampling with the overflow sampling indicated the effect of storm water in diluting the concentration of the wastes under overflow conditions. The sampling results indicated the TSS range to be from 82 mg/1 to 213 mg/1 and the BOD range to be 15 mg/1 to 95 mg/1. The peak concentrations are indicative of the flushing action present in combined sewer collection systems.

MULBERRY STREET OVERFLOW CHAMBER

This chamber serves a tributary area of only 4 acres, consisting of one city block with combined sewers. There is only one building connection to this line and this chamber could readily be eliminated.

Metering and sampling facilities were installed in the Mulberry Street chamber from June 29, 1975 to August 14, 1975. The seven overflows that were recorded during this period were not true overflows but were caused by the interceptor backing up.

Samples of the storm flows into the Mulberry Street chamber were taken and the results indicated minimal amounts of pollution. The suspended solids were found to be about 107 mg/l and the BOD concentration ranged from 11 mg/l to 27 mg/l.

WEST BROADWAY OVERFLOW CHAMBER

The West Broadway overflow chamber serves a combined sewer area of only 4 acres. Again, this limited area serves only a few dwellings. The average daily flow ranges seasonally from about 0.07 to 0.11 MGD. The infiltration was found to be exceptionally high in this collection district, since a dry weather flow of 0.02 MGD would be representative of the theoretical flow.

Observations and measurements were made in this chamber for the period of May 13, 1975 to August 17, 1975.

Based on the size of the collection area, no overflow is expected at this chamber. During the aforementioned study period, overflow was recorded nine times. It is believed that this overflow was due to the lack of capacity in the PVSC interceptor sewer causing an overflow through the overflow chamber from the interceptor itself.

This chamber, like the Mulberry Street Chamber, can be eliminated due to the small collection area it serves.

Samples of the storm flows into the West Broadway chamber were taken, and the results indicated an average concentration of suspended solids of 219 mg/l, and a minimal concentration of BOD ranging from a low of 24 mg/l to a high of 42 mg/l.

BANK STREET OVERFLOW CHAMBER

The Bank Street overflow chamber serves a combined sewer area of only 4 acres and relatively few connections. No overflows were measured or observed at this chamber during the period of observation and study, extending from June 29, 1975 to August 7, 1975.

Samples taken of the storm flow into the Bank Street chamber were found to be extremely diluted, being mainly storm water. The average concentration of TSS was found to be about 50 mg/l and the BOD to be about 9 mg/l.

Like the Mulberry Street and West Broadway chambers, the Bank Street overflow chamber is not expected to overflow under any rainfall condition and can be readily eliminated.

BRIDGE STREET OVERFLOW CHAMBER

The Bridge Street overflow chamber serves a tributary area of approximately 63 acres. The sewers in this district are combined and the average daily dry weather flow was found to be 0.17 MGD.

Metering and sampling apparati were installed in this chamber from June 5, 1975 to August 7, 1975. During this period, only one overflow condition was recorded with a peak overflow rate of 2.1 MGD for a total overflow volume of 0.2 MG.

Sampling results of the sewage flow under dry weather conditions, when compared to the characteristics of domestic sewage, revealed a somewhat above average TSS concentration of 392 mg/l and a below average BOD concentration of 92 mg/l.

Sampling during rainfall conditions indicated the TSS concentration to range from about 25 mg/l to about 90 mg/l. The BOD concentration ranged from 77 mg/l to 92 mg/l.

During the observation period, changes in the collection system by urban renewal have resulted in a diminution, if not complete elimination, of overflow at this chamber. Like Mulberry Street, the Bridge Street overflow chamber can be eliminated in the future.

NORTHWEST STREET OVERFLOW CHAMBER

The Northwest Street overflow chamber serves a tributary area of approximately 283 acres. This drainage area is provided with combined sewers, and the average daily dry weather flow was found to be 2.0 MGD.

Metering and sampling facilities were installed in this chamber and were in service from January 18, 1975, through August 7, 1975. During this period of time, 41 rainfall occurences were observed and 35 overflows occurred, indicative of 85 percent probability of overflow as a result of rainfall. Overflows were found to occur whenever the average rainfall intensities were in excess of about 0.06 to 0.07 inches per hour.

At this station, the volume of overflow was found to be nominal, ranging from about 0.2 MG to about 5.5 MG. Peak flow rates were found to be very high, ranging from about 75 to 90 MGD when high rates of rainfall intensity occurred.

It has been estimated that 70 to 90 rainfall occurrences are likely in the average year, which will result in 60 to 70 overflows at the Northwest Street overflow chamber.

During the study period, sampling of the dry weather flow indicated the presence of industrial wastes, as well as domestic sewage. The BOD ranged from 174 mg/1 to about 1,300 mg/1. The TSS concentration averaged about 180 mg/1.

The overflow waste characteristics indicated that the average BOD ranged from about 36 mg/1 to about 202 mg/1. The suspended solids, however, were found to vary greatly, namely, from 39 mg/1 to 687 mg/1, which appears to be a flushing action resulting from high intensity rainfall and high overflow rates.

ARCH STREET OVERFLOW CHAMBER

The Arch Street overflow chamber serves a tributary area of only 32 acres. This area is served entirely by combined sewers. The average daily dry weather flow in the system was estimated to be about 0.15 MGD.

Metering and sampling facilities were installed and were in service in this overflow chamber for the period beginning on March 30, 1975 and ending on August 6, 1975. During this period of time, fifteen rainfall occurrences were observed, in which overflow to the river was metered or observed to have occurred fourteen times.

During this period, the volumetric discharge in the Passaic River was found to be minimal, ranging from about 0.2 MG to 0.6 MG. However, the peak flow rates were found to range from 2.5 MGD to 15.0 MGD during periods of maximum rainfall intensity.

It has been estimated that the Arch Street overflow chamber will be activated 60 to 70 times per year based upon rainfall occurring 70 to 90 times per year.

Sampling of the dry weather flow at the Arch Street chamber indicated somewhat diluted domestic waste, with suspended solids averaging 110 mg/l and BOD about 140 mg/l. The sampling of the combined storm overflow indicated high concentrations of TSS, at about 500 mg/l, and of BOD, at about 360 mg/l, at peak rainfall intensity rates reflecting the flushing action expected in combined sewers. Following this flushing action, the sampling indicated a dilute effluent, with TSS ranging less than about 50 mg/l, and BOD averaging 37 mg/l.

JEFFERSON STREET OVERFLOW CHAMBER

The Jefferson Street overflow chamber serves a tributary area of about 38 acres which is served with combined sewers. The average daily dry weather flow was estimated to be about 0.2 MGD. There is no outlet to the river from this chamber. The outlet from the chamber to the existing outfall piping has been sealed off with a masonry plug. Thus, with any storm, the system becomes surcharged and the flow is conveyed downstream to the Hudson Street overflow chamber.

The sealing of this overflow chamber was necessitated by the fact that overflow was occurring on a daily basis due to the surcharging of the PVSC branch sewer. The action, taken in the past, of sealing off this chamber and diverting the flow to the Hudson Street chamber, resulted in the elimination of daily discharges to the Passaic River.

The quality of the sewage under dry weather flow conditions was found to be typical of ordinary domestic sewage. The results of the analysis indicated the average TSS concentration to be about 230 mg/l and the BOD concentration, about 240 mg/l.

During storm flow conditions, the results of the analysis indicated a more dilute sewage. The TSS concentration was found to range from 157 mg/l to 420 mg/l, and the BOD concentration from 34 mg/l to 966 mg/l.

STOUT STREET OVERFLOW CHAMBER

The Stout Street overflow chamber serves a tributary area of only 15 acres which is served with combined sewers. The average daily dry weather flow is negligible. This chamber, like the Jefferson Street chamber, has no outlet to the river. The outlet from the chamber to the existing outfall piping has been sealed off with a masonry plug. Thus, with any storm, the system becomes surcharged and the flow is conveyed downstream to the Hudson Street overflow chamber.

The sealing of this overflow chamber was necessitated by the fact that overflow was occurring on a daily basis due to the surcharging of the PVSC branch sewer. The action, taken in the past, of sealing off this chamber and diverting the flow to the Hudson Street chamber, resulted in the elimination of daily discharges to the Passaic River.

The quality of the sewage under dry weather flow conditions was found to be diluted and not typical of ordinary domestic sewage. The results of the analysis indicated the average TSS concentration to be about 83 mg/l and the BOD concentration about 39 mg/l, reflecting a high rate of infiltration in the Stout Street area.

During storm flow conditions, the results of the analysis indicated a more dilute sewage. The TSS concentration was found to range from 12 mg/l to 36 mg/l.

NORTH STRAIGHT STREET OVERFLOW CHAMBER

The North Straight Street overflow chamber serves a tributary area of about 82 acres which is served with combined sewers. The average daily dry weather flow was found to range from 0.39 MGD to 0.43 MGD, seasonally. The variation in measured flows is indicative of the high infiltration rate in this collection area. There is no outlet to the river from this chamber. The outlet from the chamber to the existing outfall piping has been sealed off with a masonry plug. Thus, with any storm, the system becomes surcharged and the flow is conveyed downstream to the Hudson Street overflow chamber.

The sealing of this overflow chamber was necessitated by the fact that overflow was occurring on a daily basis, due to the surcharging of the PVSC branch sewer. The action, taken in the past, of sealing off this chamber and diverting the flow to the Hudson Street chamber resulted in the elimination of daily discharges to the Passaic River.

Sampling of the sewage under dry weather flow conditions indicated the presence of industrial waste periodically in high concentration. The results of the analysis indicated the TSS concentration to vary from 16 mg/1 to 692 mg/1 and the BOD concentration varied from 59 mg/1 to 1620 mg/1. These variations in concentration are indicative of the peak industrial discharges into the system.

During storm flow conditions, the results of the analysis indicated a more dilute sewage. The TSS concentration was found to range from 52 mg/1 to 176 mg/1.

HUDSON STREET OVERFLOW CHAMBER

The Hudson Street chamber overflows whenever the storm flow from Jefferson Street, Stout Street, North Straight Street, and the residual storm flow from Northwest Street and Arch Street surcharges the existing PVSC branch sewer on the north side of the Passaic River. The area essentially served by this overflow consists of 450 acres, serving the following districts:

Jefferson Street	38 acres
Stout Street	15 acres
North Straight Street	82 acres
Northwest Street	283 acres
Arch Street	32 acres
TOTAL	450 acres

The average daily flow in the combined sewer which passes through this chamber, under dry weather flow conditions, is 3.5 MGD. During wet weather months, the average flow increases to about 4.4 MGD, which is indicative of very high infiltration in the collection districts.

Metering and sampling equipment was installed in this chamber and observations were made over a period extending from January 1, 1975, through August 7, 1975. During this period of time, 46 rainfalls were measured or observed and overflows occurred at this chamber on 21 occasions, or 46 percent of the time.

The volume of overflow was not found to be very high at this chamber. The overflow ranged from a low of about 0.2 MG to an overflow in excess of 5.3 MG. The peak overflow rates were not found to be excessive and rates of up to approximately 18.5 MGD were recorded.

From the foregoing results, it has been determined that overflow will occur at the Hudson Street chamber 30 to 40 times per year based on rainfalls occurring 70 to 90 times per year.

The quality of the pollutional load on the river was indicated by the sampling results as being typical domestic sewage, with an average BOD concentration of 185 mg/l and suspended solids of about 205 mg/l.

More meaningful than the overflow readings at the Hudson Street chamber are the composite results of the overflow readings and analysis combined with Northwest Street, Arch Street and Hudson Street.

In reviewing the results of the Northwest Street, Arch Street, and Hudson Street overflow chambers, it was found that all three chambers are triggered under essentially the same storm flow conditions, and that the aggregate overflow from the three chambers, under rainfalls of long-term duration and high intensity, approached about 11.4 MG. The peak overflow rates in the aggregate at these three stations was about 125 MGD. In general, the quality of the effluent discharged into the river was found to be representative of dilute sanitary sewage, with indications of high suspended solids where peak overflow rates were substantially greater than the dry weather flow.

MONTGOMERY STREET OVERFLOW CHAMBER

The tributary area served by the Montgomery Street overflow chamber is 667 acres. This area is served entirely by combined sewers.

The average daily flow was found to range seasonally from 2.83 MGD to 3.84 MGD, compared to an estimated theoretical flow of 1.87 MGD in this district. It is evident that a high infiltration rate exists in the collection system. A small area under an urban renewal program has separate sanitary sewers, but this area is insignificant.

Metering and sampling facilities were installed in this chamber from February 23, 1975, to June 6, 1975. During this period of time, rainfall occurred on 20 occasions. The rainfall ranged from only 0.05 inches to a high of 1.42 inches. During this period of study, 16 overflows were measured or observed to have occurred. Overflows occurred about 80 percent of the time. It was found that, when the average rainfall intensity approached or exceeded 0.06 inches per hour, overflow was likely to occur.

It was observed that the volume of overflow was nominal, ranging from about 0.5 MG to about 5.4 MG per rainfall occurrence. Peak overflow rates, however, were found to range in excess of 44 MGD, depending upon the intensity of the rainfall.

It has been estimated that overflow will occur at this chamber 55 to 75 times per year, based upon rainfall occurring 70 to 90 times per year.

The sewage flow at the Montgomery Street overflow chamber was sampled during dry weather conditions and the results indicate primarily domestic sewage tributary to this chamber. The TSS was found to range from 10 mg/l to 122 mg/l, and the BOD from 29 mg/l to 263 mg/l. The low concentrations of TSS and BOD are indicative of the ground water infiltration present in the Montgomery Street collection area.

The results of overflow sampling indicated that the waste concentration was not too severe, with BOD values ranging from about 65 mg/l to 140 mg/l. The suspended solids, likewise, were found to be nominal, ranging from about 35 to 150 mg/l. The overflow from Montgomery Street appeared to be a typical, dilute sanitary sewage with little, if any, industrial waste.

STRAIGHT STREET OVERFLOW CHAMBER

The Straight Street overflow chamber serves a tributary area of approximately 121 acres. The area is served by a combined sewer system. The average daily flow was found to range seasonally from 0.84 MGD to 1.80 MGD. This variation in flow is indicative of the high infiltration rate in this area, which is typical of combined sewer systems.

Measurements and observations were made at this overflow during the time period from February 23, 1975, through June 1, 1975. Eighteen rainfalls were observed during this period, and it is estimated that overflow occurred on sixteen of these occasions.

The volume of discharge into the river was not very great at this station, ranging from about 0.5 MG to a high of 1.3 MG. However, the peak flow rates were found to range from as low as 5 MGD to as high as 40 to 57 MGD.

Based on the foregoing results, it is estimated that overflow will occur at this location 60 to 75 times per year based on rainfall occurring 70 to 90 times per year.

Results of sampling taken at this overflow chamber under dry weather conditions were typical of diluted domestic sewage. The TSS ranged from 28 mg/l to 298 mg/l and the BOD ranged from 27 mg/l to 330 mg/l.

An analysis of the overflow indicated that the BOD ranged from 110 mg/l to 313 mg/l and that the suspended solids ranged from 100 to 346 mg/l. In general, this area is comprised of residential dwellings, and the test results are indicative of typical domestic sewage overflow combined with storm water.

FRANKLIN STREET OVERFLOW CHAMBER

The Franklin Street Overflow Chamber serves a combined sewer area of only 2 acres, with only one connection. No overflows were measured or observed at this chamber during the period of observation and study, extending from June 29, 1975 to August 7, 1975.

Like the Mulberry Street, West Broadway and Bank Street overflow chambers, the Franklin Street chamber is not expected to overflow under any rainfall condition and can be readily eliminated.

Samples taken of the storm flow into the Franklin Street chamber were found to be somewhat diluted, being mainly storm water. The average concentration of TSS was found to be about 82 mg/l and the BOD to be about 133 mg/l.

KEEN STREET OVERFLOW CHAMBER

The Keen Street overflow chamber serves a tributary area of approximately 11 acres. The district is served entirely with combined sewers. The average daily dry weather flow was found to range seasonally from 0.33 MGD to 0.69 MGD.

Metering facilities were installed in this chamber and observations were made over a period extending from March 29, 1975 to August 7, 1975. During this period of time, 30 rainfalls were observed and overflow occurred on 22 occasions.

It was observed that overflows did occur during periods of heavy rainfall and high rainfall concentrations. However, the volume of storm water overflow discharged into the river was found to be nominal, ranging from a negligible amount to a maximum of 0.6 MG. The peak overflow rates were found to be approximately 19 MGD.

Based on the foregoing, it is estimated that overflow will occur at this station 50 to 70 times per year, based on rainfall occurring 70 to 90 times per year.

Sampling results of the dry weather flow were indicative of typical domestic sewage, with the average TSS being 155 mg/l and the average BOD being 203 mg/l. The results of the overflow analysis indicated, as expected, a more dilute sewage. The TSS concentration concentration was found to range from 83 mg/l to 270 mg/l and the BOD concentration averaged about 15 mg/l.

SHORT STREET OVERFLOW CHAMBER

The Short Street overflow chamber serves a tributary area of approximately 32 acres. This area consists of combined sewers, and the average daily flow was found to range seasonally from 0.51 MGD to 0.86 MGD. The domestic sewage from Prospect Park connects with the City of Paterson system at this chamber; therefore, the flow which is discharged in the Passaic River at this chamber includes some protions of the Prospect Park domestic waste. The average daily flow from Prospect Park was found to be about 0.3 MGD, year-round.

This vast variation in flow is indicative of the high infiltration rate present in the Short Street collection area during periods of relatively high ground water table. Metering and sampling facilities were installed in this chamber and were observed for the period beginning March 29, 1975 and extending through May 30, 1975. During this period of time, rainfall occurred on thirteen occasions and overflows were found to have occurred on eleven occasions.

Based on the foregoing, it is estimated that overflow will occur at this chamber 60 to 70 times per year with rainfall occurring 70 to 90 times per year.

The overflow volume was found to be very small, ranging fron 0.1 to 0.7 MG. The peak rates of overflow were not excessive, although a high storm flow rate of about 9 MGD was measured.

Sampling of the dry weather flow indicated characteristics typical of domestic sewage. The average TSS was found to be 135 mg/l and the average BOD to be 188 mg/l.

Sampling taken during overflow conditions indicated a BOD which ranged from 85 mg/1 to 283 mg/1. The suspended solids were found to range from about 20 mg/1 to 222 mg/1. The wide range in sampling was indicative of the extended intensity, as well as duration, of the rainfall. In other words, during the initial flushes, the concentrations of waste were found to be greater than those which occurred during periods of heavy rainfall of long-term duration.

BERGAN STREET OVERFLOW CHAMBER

This overflow chamber serves a tributary area of approximately 11 acres. The area is served with combined sewers and the average daily flow was found to be about 0.07 MGD. Measurements and observations of overflow at this chamber extended over a period of time beginning on June 12, 1975, and extending through November 8, 1975. During this period of time, 28 rainfalls occurred and overflows were measured or observed to have occurred on 25 occasions.

It was observed that the branch interceptor sewer extending from the Short Street Overflow Chamber to the Bergan Street Chamber was surcharged, resulting in additional overflow at the Bergan Street Chamber. This was observed to have occurred on some occasions even when no rainfall occurred.

Based on the foregoing, it is estimated that overflow will occur at the Bergan Street chamber 65 to 80 times per year for rainfalls occurring 70 to 90 times per year.

The analysis of the dry weather flow at the Bergan Street overflow chamber indicated erratically high concentrations of TSS and BOD. The TSS concentration ranged from 84 mg/l to 3,872 mg/l. The BOD ranged from 70 mg/l to 2,085 mg/l. These high concentrations of pollutants are attributable to industrial waste discharges in the Bergan Street district.

Sampling results of storm overflows indicated an average TSS concentration of 121 mg/l and an average BOD concentration of 258 mg/l. These results are somewhat lower than the dry weather results, demonstrating the effect of dilution.

WARREN STREET OVERFLOW CHAMBER

The Warren Street chamber has a tributary area of approximately 81 acres. This area is served by combined sewers, and the average daily flow was found to vary seasonally from approximately 1.4 MGD to about 1.9 MGD, indicative of the high infiltration rate present in combined sewers. This chamber serves only the tributary area of 81 acres and is not affected by the in-line interceptor sewer flow which serves the Short Street and Bergan Street tributary areas.

Observations and measurements were made of overflow in this chamber during the period beginning January 29, 1975 and extending through March 24, 1975. Nine rainfalls occurred during this period of time, and overflow at the chamber was measured or observed to have occurred on seven occasions.

The volume of overflow from this chamber was estimated to range from a negligible amount to 2.0 MG, with peak overflow rates reaching about 11 MGD.

Based on the foregoing, it is estimated that overflow will occur at this chamber 55 to 70 times per year with rainfalls occurring 70 to 90 times per year.

Samples were taken of the dry weather flow to obtain the waste characteristics and they were found to be typical of domestic sewage. The TSS average concentration was found to be 180 mg/l and the BOD to be 233 mg/l, on an average basis.

Samples were also taken of the overflow which occurred and the results indicated the TSS concentration to range from 121 mg/l to 284 mg/l and the BOD from 86 mg/l to 422 mg/l. The high concentrations of TSS and BOD are representative of the flushing action in combined sewers occurring at peak rainfall intensity rates.

SIXTH AVENUE OVERFLOW CHAMBER

The Sixth Avenue overflow chamber has a tributary area of 50 acres served by combined sewers. The average daily flow at this chamber was found to vary seasonally from about 0.09 MGD to 0.11 MGD.

Metering and sampling facilities were installed in this chamber and observations of overflow were made over the period beginning May 13, 1975 and extending to October 24, 1975. Overflow did not occur at this chamber due to the lack of excessive combined storm flows. The storm water from a portion of the tributary area has been separated from the combined sewers and is conveyed to the river by a storm sewer on Sixth Avenue. Therefore, the combined sewage flow is not as great as in other similar areas. Secondly, the overflow outlet pipe has been clogged with debris and when overflows were about to occur, the clogging prevented a free outlet, resulting in surcharge at these chambers. In addition, the main interceptor backs up into the branch sewers, causing surcharging into the chamber.

It has been estimated, however, that with the debris removed from the outlet line, overflows would have occurred on approximately 15 occasions, based on 26 rainfalls observed during the period of study. It will be noted that this is somewhat less than does occur in other districts where the combined sewer systems serve the entire tributary area.

Based on the foregoing, it is estimated that overflow can occur at the Sixth Avenue chamber from 40 to 50 times per year, for rainfalls occurring 70 to 90 times per year.

Sampling of the sewage flow under dry weather conditions indicated the presence of industrial waste, with peak TSS and BOD concentrations of 644 mg/l and 1342 mg/l, respectively. The minimum TSS reflecting the presence of infiltration in the collection area. Results of storm sampling indicated a diluted waste, with the TSS ranging from a low of 64 mg/l to 318 mg/l. The BOD was found to range from 30 mg/l to 145 mg/l.

EAST FIFTH STREET AND FIFTH AVENUE OVERFLOW CHAMBER

This overflow chamber serves a very small area of approximately 10 acres comprising a few industries. The average daily dry weather flow was found to be about 0.13 MGD.

Metering and sampling facilities were installed in the chamber during the period extending from March 19, 1975, to July 6, 1975. During this period, overflows were found to have occurred on 14 occasions, with rainfall occurring on 18 occasions. The volumetric discharge into the Passaic River was found to be minimal, ranging from a negligible amount to about 0.4 MG. However, the peak overflow rates were found to range from 2.2 MGD to 11.5 MGD, depending on the rainfall intensity.

It has been estimated that overflow will occur at this chamber about 50 to 65 times per year, based upon rainfall occurring 70 to 90 times per year.

Sampling results of the dry weather flow, tributary to this chamber, were indicative of low polluting industrial wastes. The TSS concentrations were found to range from about 22 mg/l to about 288 mg/l. The BOD concentrations ranged from 12 mg/l to 146 mg/l. The low concentrations of TSS and BOD are indicative of the presence of infiltration during the non-operational hours of the industries discharging into this line.

The results of the overflow sampling indicated minimal amounts of pollution being discharged into the river. The TSS concentration was found to vary from 69 mg/l to 212 mg/l and the BOD varied from 21 mg/l

to 390 mg/1. The peak concentrations of TSS and BOD are indicative of the flushing action experienced in combined sewers, due to peak rainfall intensity.

Investigations of the East Fifth Street collection area indicated that it would be possible to readily eliminate the storm water connections to the system, thus eliminating all overflow and assuring that the industrial wastes are delivered into the collection system without dilution and subsequent overflow into the Passaic River.

EAST ELEVENTH STREET OVERFLOW CHAMBER

This overflow chamber serves a tributary area of only 104 acres. The collection system consists of combined sewers. The average daily dry weather flow was found to be 0.89 MGD.

The metering and sampling facilities were installed in this chamber and were in service from February 5, 1975, to June 13, 1975, during which time 24 rainfall occurrences were measured or observed. Twenty-one overflows were measured or observed which is indicative and an 88 percent probability of overflow as a result of rainfall. It was found that, when the average intensity approached or exceeded 0.03 inches per hour, overflow was likely to occur.

The volume of overflow from this chamber was found to be nominal, ranging from a low of about 0.1 MG to a high of 5.0 MG. However, the peak overflow rates were found to be in excess of 40 MGD for several storms, where high rates of rainfall intensity occurred. It was observed--and this was noted at other overflow stations--that rainfalls of relatively short-term duration but of very high intensity, would result in peak overflow rates, but in nominal volumetric discharges because of the short time-duration of the storms. On the other hand, rainfalls of modest intensity but of long-term duration resulted in modest peak overflow rates and higher volumetric discharges.

It has been estimated that from 70 to 90 rainfall occurrences are likely in the average year which will cause an overflow at this chamber about 50 to 70 times.

Dry weather sampling of the sewage flow at this overflow chamber indicated the presence of industrial wastes, as well as domestic sewage. The TSS was found to range from 36 mg/l to 446 mg/l and the BOD ranged from 13 mg/l to 485 mg/l. The low concentration of TSS and BOD is indicative of the groundwater infiltration present in the East Eleventh Street collection area.

The pollutional loading of the overflow was found to be nominal at this station, with the BOD ranging from 21 mg/l to a high of 125 mg/l, indicative of the effect of dilution at this chamber. The suspended solids in the overflow were likewise found to be nominal, ranging from about 23 mg/l to 129 mg/l.

EAST 12TH STREET AND FOURTH AVENUE OVERFLOW CHAMBER

This overflow chamber serves an area of approximately 19 acres comprising a combined sewer system. The average daily dry weather flow was found to be 0.27 MGD.

Metering and sampling facilities were installed and observations were carried out at this overflow chamber for the period beginning May 16, 1975 and extending to November 13, 1975. During this period of time, rainfall occurred on 37 occasions and it is estimated that overflows occurred on 28 of those occasions.

The overflow volume at this chamber was found to be minimal, ranging from a negligible amount to 0.20 MG. Peak overflow rates were found to be about 12.5 MGD.

Based on the foregoing, it is estimated that overflow will occur at this chamber from 50 to 70 times per year if rainfall occurs 70 to 90 times per year.

Sampling results of the dry weather daily flow indicated the presence of industrial waste but not in high concentrations. The TSS concentration at minimum daily flow periods was found to be negligible, and at peak daily flows it was found to be as high as 184 mg/l. Likewise, the BOD concentration was found to be as low as 41 mg/l and as high as 444 mg/l, respectively.

Automatic sampling was very difficult to achieve in this chamber because of the condensation conditions which prevail. These conditions, created by the discharge of steam or hot water which probably exceed the limitations of discharge into the collection system, impaired

the sampling of the overflow. Therefore, sampling of the storm flow at this location was accomplished manually. The results of the manual sampling indicated a relatively low concentration of TSS, averaging 47 mg/l and a high concentration of BOD, averaging 649 mg/l. It is evident that the sampling was carried out during periods of peak industrial discharge, resulting in minimal dilution due to storm water.

SECOND AVENUE OVERFLOW CHAMBER

The Second Avenue Overflow Chamber has a tributary area of 45 acres and is served entirely by combined sewers. The average daily flow was found to be about 0.54 MGD.

Metering and sampling facilities were installed in this chamber and overflow observations were made during the period beginning January 18, 1975 and extending through August 25, 1975. During this period of time, rainfall occurred on 43 occasions and overflow into the Passaic River is estimated to have occurred on 28 occasions.

The volumetric overflow from this chamber to the Passaic River was minimal and ranged from a negligible amount to 0.3 MG. Peak overflow rates of approximately 10.0 MGD to 13.1 MGD were observed during periods when the rainfall of high intensity occurred.

It is estimated that overflow will occur at this chamber from 45 to 60 times per year based on rainfalls occurring 70 to 90 times per year.

The dry weather flow waste characteristics are representative of industrial waste in nominal concentration. The average TSS concentration was found to be about 92 mg/l and the BOD, 443 mg/l.

Samples were also taken of the overflows which occurred at this chamber and the following are typical of the results obtained. The peak pollution loadings occurred shortly after the beginning of the rainfall with TSS concentrations as high as 492 mg/l, and with a BOD concentration of 129 mg/l. These high pollution loadings are indicative of

the flushing action present in combined sewers. The pollution was found to decrease as rainfall continued; the TSS decreased to a low of 4 mg/l and the BOD to a low 30 mg/l.

THIRD AVENUE OVERFLOW CHAMBER

The Third Avenue overflow chamber has a tributary area of approximately 73 acres. This district is served entirely by combined sewers. The average daily flow was found to be about 0.7 MGD.

Metering and sampling facilities were installed in this chamber for the period beginning February 12, 1975 and extending through July 9, 1975. During this period of time, rainfall occurred on 15 occasions. Overflow has been estimated to have occurred approximately 13 times during this time period.

The volumetric overflow to the Passaic River was estimated to range from 0.2 MG to 0.7 MG. The peak overflow rates were measured as high as 20.8 MGD.

It is estimated that overflow will occur at this chamber from 60 to 80 times per year based on rainfall occurring 70 to 90 times per year.

The results of the sampling of the dry weather flow indicated the presence of industrial waste intermingled with domestic waste. The average TSS concentration was found to be 316 mg/l and the average COD concentration 1050 mg/l.

Sampling of the overflow also indicated that the waste water characteristics reflected the industrial waste in this tributary district. The sampling results were representative of a diluted sewage. The TSS concentrations ranged from 17 mg/l to 644 mg/l, and the BOD averaged 27 mg/l.

TENTH AVENUE AND EAST THIRTY-THIRD STREET OVERFLOW CHAMBER

This overflow chamber serves a tributary area of 699 acres all of which are served entirely by combined sewers.

The average daily dry weather flow was found to range from 5.34 MGD to 6.70 MGD, seasonally. Compared to the estimated theoretical flow of 2.65 MGD, it is evident that a high infiltration rate exists in the collection system. This condition is typical of combined sewers which were constructed with the intent of allowing extraneous water to enter the system.

The metering facilities and sampling equipment for this overflow chamber were in service beginning on December 7, 1974, and extending through June 6, 1975.

During this period of metering and observation, 34 rainfalls occurred with observed or metered overflows on 23 occasions. Thus, overflows occurred about 68 percent of the time that rainfall occurred. Again, the overflows were related to rainfall duration and intensity. In general, no overflow would occur if the rainfall intensity was about 0.025 inches per hour, or less. At a rainfall intensity of 0.04 inches per hour or more, overflows would occur, and their duration was found to be generally the same as the duration of the rainfall period. Thus, overflow duration generally did not exceed the period of rainfall.

It was found that the volume of overflow was not very great and ranged from only about 0.2 MG to about 6.6 MG. However, the peak rates of overflow were found to be very high and ranged from about 6 MGD to over 90 MGD, with the majority being in the range of 60 to 70 MGD, depending upon rainfall intensity.

Based upon observations at this chamber, it would appear that about 50 to 70 overflows are likely to occur per year, for 70 to 90 rainfall occurrences per year.

The pollutional discharge at this chamber was found to be very high. In general, the suspended solids were in the range of 300 mg/l and higher, which appeared to be indicative of the flushing action resulting from peak discharges during storm flow conditions. The BOD readings were not found to be excessive and were somewhat more dilute than found in other overflow chambers, with values ranging from a low of about 75 mg/l to a high of about 200 mg/l. The results of this study indicated that the Tenth Avenue and East Thirty-Third Street overflow was comprised of a mixture of storm water and domestic sewage with little industrial wastes, as compared with the findings at the Market Street overflow chamber.

20TH AVENUE OVERFLOW CHAMBER

The 20th Avenue overflow chamber serves an area of about 96 acres. The area is served entirely with combined sewers and the average daily flow was found to be only 0.13 MGD.

Metering and sampling facilities were installed in this chamber beginning on April 24, 1975, and extending through October 24, 1975. During this period of time, rainfall occurred on 24 occasions and overflows are estimated to have occurred approximately 16 times. The volume of overflow to the river was found to be minimal, ranging from 0.1 MG to 0.3 MG, with peak rates of overflow approximating 16.5 MGD.

It is estimated that overflow will occur at this chamber from 45 to 60 times per year based on rainfall occurring 70 to 90 times per year.

The waste characteristics of the dry weather flow are indicative of industrial sewage, primarily. The BOD was found to average approximately 1028 mg/l and the TSS, 79 mg/l.

The results of sampling of overflow reflect the dilution effect of storm water comingling with the sanitary wastes. The initial TSS concentration was found to be 1227 mg/l, reflecting the street washing resulting from heavy rainfall. As the rainfall continued, the TSS concentration was found to decrease to 80 mg/l. The BOD concentration was found to average 389 mg/l throughout the rainfall.

MARKET STREET OVERFLOW CHAMBER

The Market Street overflow serves a tributary area of approximately 1,487 acres, all of which are provided with a combined sewer system. The theoretical dry weather flow in this tributary area was determined to be approximately 7.5 MGD, whereas the actual dry weather flow was found to be approximately 13.6 MGD. Under wet weather months, the average daily flow was found to be approximately 16.2 MGD. From the above, it is obvious that very high infiltration occurs in the Market Street area, which is attributed to the type of construction of the combined sewer system and the high water table in this area.

Under storm flow conditions, it was found that this overflow is activated with essentially every rain.

The Market Street overflow chamber is an outlet for the combined sewer system of downtown Paterson. The discharge into the Passaic River from this chamber is located near the Market Street Bridge.

In recent years, the City of Paterson constructed nine overflow chambers located within the downtown area to provide relief from surcharge of the existing inadequate system. These nine overflow chambers discharge into a relief line which carries the combined overflow directly into the Passaic River. The largest and most important overflow chamber is located in the intersection of Vreeland Avenue and 19th Avenue at East 36th Street. This chamber is located at a point where a 72-inch diameter sewer is connected to an 84-inch diameter sewer at said intersection. The overflow chamber was constructed by cutting

a twenty-foot long section out of the 72-inch diameter pipe, thus creating a side overflow weir. The chamber discharges into a 90-inch diameter outlet sewer, which extends from the intersection of Vreeland Avenue and 19th Avenue to the Passaic River. The overflow chamber operates automatically whenever the flow in the 72-inch diameter pipe is at a depth greater than the weir elevation, which is only about 4 inches above the nominal daily high water sewage flow in the existing line. Observations made in the field indicate that this chamber operates with every rainfall, coincidentally with, and possibly prior to, the overflow which was measured and sampled at the Market Street outlet. In addition to this overflow chamber, eight other chambers are located in the downtown district of Paterson, of which seven are located in Trenton Avenue, and another is located at the intersection of Vernon Avenue and Maryland Avenue. These overflows likewise were found to be operating automatically and discharging into relief lines constructed for this purpose to discharge the overflow into the Passaic River. The outlet line discharges into the Passaic River near Maryland Avenue.

The metering and sampling facilities which were installed in Market Street, Paterson, were in service from a period beginning December 7, 1974, through April 24, 1975. Thus, for a period of approximately five months, observations were made of overflow at this chamber. Twenty-four rainfalls occurred during the period of metering and observation of various time-durations and rainfall intensity. Overflow occurred at this chamber approximately twenty-one times. No overflow occurred when rainfall was

very light, with intensities of approximately 0.01 to 0.05 inches per hour. However, at intensities generally of about 0.06 inches per hour, or more, overflow occurred. An examination of the records of rainfall indicated that a majority of the rainfall intensities during the period of observation ranged from 0.05 to about 0.10 inches per hour and, of course, overflow occurred under these conditions.

The volume of overflow was not very high, and this was attributed to the fact that the overflow facilities constructed by the City of Paterson probably discharged an amount equal to or more than the overflow observed at this chamber. The volume of overflow for most of the storms ranged from about 5 MG to as high as 15 MG. Peak rates of discharge generally ranged from about 60 to 90 MGD during the storms of severe rainfall intensity.

Based upon the observations, it appears that 60 to 75 overflows per year can be anticipated at this overflow chamber dependent upon the number of times that rainfall occurs. In general, overflow is likely to occur approximately 80 to 90 percent of the time that rainfall occurs.

The quality of the overflow was determined by sampling and testing during some of the overflow occurrences. It was observed that there was an extreme variation in the quality of the overflow and, in general, the average quality is considered to be objectionable with BOD values averaging from about 159 mg/l to 545 mg/l. Likewise, the suspended solids were found to be extremely high and, in general, the quality of the overflow is indicative of highly polluted water.

REPORT UPON

OVERFLOW ANALYSIS

TO

PASSAIC VALLEY SEWERAGE COMMISSIONERS

PASSAIC RIVER OVERFLOWS

CLIFTON • PASSAIC • RUTHERFORD AREA

1976

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Environmental and Hydraulic Engineers 46 ESSEX STREET MILLBURN NEW JERSEY 07041

CLIFTON-PASSAIC-RUTHERFORD AREA OVERFLOWS

Extent of Area and Peak Overflow Rates

Five Active and eight Inactive overflows were observed and studied in the Clifton-Passaic-Rutherford Area, which is generally the "middle" area of the PVSC system. An overflow condition was only recorded at two of the Active overflows (Washington Avenue and Stewart Avenue overflows). No overflow condition during rainfall periods was observed at the other three Active overflows.

These overflows are located along the PVSC branch interceptor sewers adjacent to the Passaic River in this area. The branch interceptor sewers in this middle area extend a distance of approximately 5.8 miles on the easterly side of the Passaic River.

The five active overflows serve a total tributary area of approximately 513 acres. Of this area, only 71 acres are served by combined sanitary and storm sewer systems. The balance is served by separate sanitary systems. The capacity of the sewer systems in these districts has been estimated to be approximately 60 Million Gallons per Day (MGD).

The estimated average daily dry weather flow in the sewer system in this middle area was found to be about 2.3 MGD. During wet weather months, when the groundwater table is high, the average daily dry weather flow (when no rainfall occurs) was estimated to be approximately 3.0 MGD. This indicates that groundwater infiltration of approximately 0.7 MGD prevails in the collection system of the Clifton-Passaic-Rutherford Area.

This infiltration occurs mainly in separate sanitary sewer systems, since only about 15 per cent of the area is served by combined sewers.

The total estimated piping of combined sewers in the Clifton-Passaic-Rutherford Area which is served with combined sewers and which is tributary to the PVSC branch interceptor sewers, is approximately two miles or 10,000 linear feet. It has been estimated that the cost of construction of separate sanitary sewers for this middle area would be approximately $1.5 million.

However, the combined sewers in this area are not the major contributors of the suspected infiltration. The two overflows on combined sewers exhibited fairly uniform flow throughout the dry and wet weather periods.

Most of the suspected infiltration in this area is associated with the area tributary to the Dundee Island overflow. In this area, the dry weather flow ranged from 1.98 MGD to 2.61 MGD during dry and wet weather months, respectively. This area is served by a separate sanitary sewer system.

The five Active overflow chambers in the Clifton-Passaic-Rutherford Area are served by drainage areas ranging in size from 34 acres to as large as 195 acres. The aggregate capacity of the combined and sanitary sewer pipelines which serve these tributary sewer areas has been estimated to be about 60 MGD. The estimated aggregate capacity of the overflow pipes from the chambers to the river has also been estimated to be about 60 MGD. For the two overflows on combined systems, this

latter aggregate capacity is 50 MGD. In other words, under conditions of an extensive storm which would inundate and surcharge the entire collection system, a flow of approximately 50 MGD could enter the two Active overflow chambers, with the possibility of discharge into the river of about an equal amount.

Table 3 has been prepared to show the salient features of the thirteen overflows in the Clifton-Passaic-Rutherford Area located along the PVSC branch interceptors. This table is entitled "Tabulation of Passaic Valley Sewerage Commissioners' Overflows in the Clifton-Passaic-Rutherford Area." This table sets forth a tabulation of the overflow location, the discharge permit number, the area tributary to each overflow chamber, the measured dry weather flow under seasonal conditions, the estimated capacity of the sewers tributary to these Active areas, the estimated overflow capacity from these Active chambers to the river, and finally, the observed recorded peak flow rates and estimated volume of discharge into the Passaic River.

Overflow Measurements

During the period of observation and study of each of the Active overflow chambers, approximately 12 to 19 rainfalls were observed. Depth-recording gauges were installed in essentially all of the Active chambers, and measurements and sampling of overflow were undertaken. Sampling during both dry weather periods and during storm flows was undertaken at the Inactive overflows.

TABLE 8

TABULATION OF PVSC OVERFLOWS IN THE CLIFTON-PASSAIC-RUTHERFORD AREA

Overflow Location	Discharge Permit Number	Tributary Area (Acres)	% of Area with Combined Sewers	DRY WEATHER FLOW		Estimated Maximum Storm Capacity (MGD)	Estimated Maximum Overflow Capacity to River (MGD)	Maximum Peak Recorded Overflow to River (MGD)	Maximum Overflow Observed (MG)
				Dry Weather Months (MGD)	Wet Weather Months (MGD)				
Active:									
Dundee Island, Passaic	070/Q-002	195	None (2)	1.98	2.61	5.8	1.0(Est.)	No Overflow (1)	
Pierrepont Avenue, Rutherford	072/R-002	96	None (2)	0.09	0.09	3.1	2.2	No Overflow	
Rutherford Avenue, Rutherford	073/R-003	151	None (2)	0.14	0.15	2.0	3.8	No Overflow	
Stewart Avenue, Kearny	017/K-001	34	100	0.06	0.06	19.6	19.6	8.7	0.4
Washington Avenue, Kearny	018/K-002	37	100	0.06	0.07	29.9	33.5	5.0	0.1
TOTAL		513	-	2.33	2.98	60.4	60.1	13.7	0.5
Inactive:									
Garden State Paper Co., Garfield	009/G-001	Industrial	None	7.60	8.90	-	-	- Inactive -	
Wallington Pump Sta., Wallington	005	2,524	None (2)	8.43	10.56	-	-	- Inactive -	
Passaic Tail Race, Passaic	069/Q-001	6	None (2)	0.10	0.10	-	-	- Inactive -	
Lodi Force Main, Passaic	027/L-001	3,246	None (2)	5.41	5.52	Force Main		- Inactive -	
Woodward Avenue, Rutherford	071/R-001	206	None (2)	0.19	0.20	-	-	- Inactive -	
Yantacaw Street, Clifton	003	Main PVSC Line Overflow		99.20	122.00	-	-	- Inactive -	
Yantacaw Pumping Station, Clifton	004	1,359	None (2)	3.10	3.80	-	-	- Inactive -	
North Arlington Overflow	006	560	None (2)	0.93	1.38	-	-	- Inactive -	

(1) Surcharged due to obstructed outfall.

(2) Area served with separate sanitary sewers

The results of these studies and measurements indicate that the maximum recorded overflow to the river from the five Active chambers during this period of study was at the peak rate of approximately 14 MGD. However, this overflow rate was of short-term duration and does not reflect the volume of overflow discharged into the river.

The volume of overflow from the five Active overflow chambers was determined to be only about 500,000 gallons during this period of observation and study under the maximum storm flows observed (not all simultaneously).

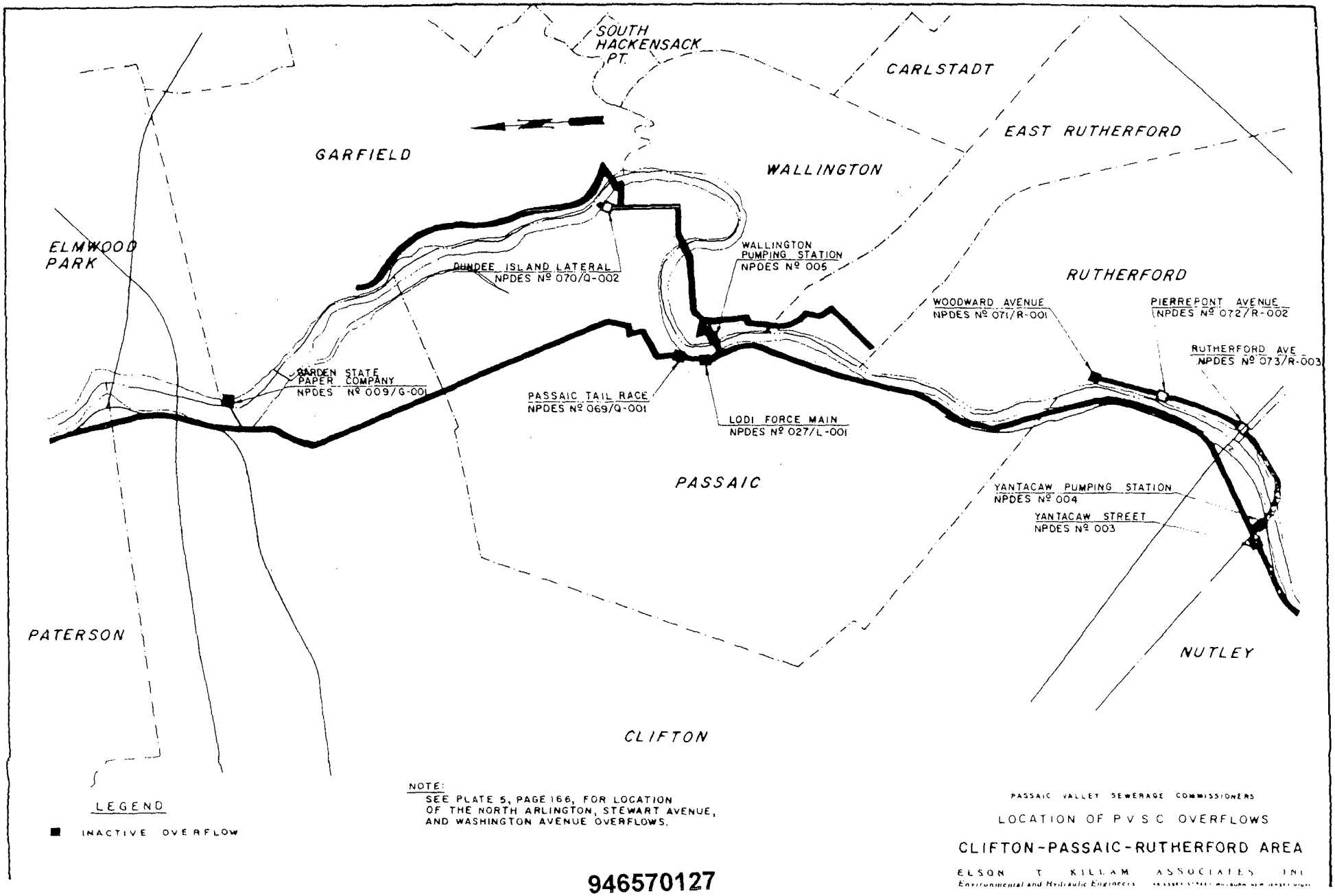
It has been found that only two of the five Active overflow stations are served by combined sewers (the Washington Avenue and Stewart Avenue chambers in Kearny). These chambers respond to a rainfall of approximately one inch occcuring in a 24-hour period, or at an average intensity of about 0.04 inches per hour. The remaining three Active chambers are all tributary to areas served by separate sanitary sewer systems (Pierrepont Avenue, Rutherford Avenue, and Dundee Island).

It was found that the overflow rates of discharge were of short-term duration and generally responded directly to the rainfall. In other words, the overflows generally ceased, following the cessation of rainfall. The aggregate overflow to the Passaic River in the Clifton-Passaic-Rutherford Area under maximum storm flow conditions observed is a very small part of the total system overflow.

The most important overflows located within the Clifton-Passaic-Rutherford area which are tributary to the Passaic Valley branch interceptor sewers are located at Washington Avenue and Stewart Avenue in Kearny. However, even these two active locations produced a recorded aggregate overflow volume of only 500,000 gallons.

The location of the PVSC main and branch interceptor sewers and the overflow chambers along the Passaic River in this middle area of the system is shown on Plate 3. All of the thirteen overflows in this middle area of the system are shown on Plate 3, except the North Arlington, Washington Avenue, and Stewart Avenue overflows which are located in the southerly part of the area. Since these three overflows are located on the Kearny-North Arlington branch interceptor (rather than the branch interceptors which serve the heart of the Kearny-Harrison area through Newark), it was felt appropriate to treat these overflows for discussion purposes with the other overflows which are located on branch interceptors north of the Newark area. The North Arlington, Washington Avenue, and Stewart Avenue overflow locations, therefore, are shown on Plate 5, covering the Kearny-Harrison area.

For the eight Inactive overflows in this middle area, no flow metering facilities were installed, since these overflows are utilized only under extraordinary circumstances, such as for relief during localized flooding or for emergency maintenance purposes. However, sampling of the sewage flow in the immediate area of these overflows was performed during both dry weather (non-rainfall) periods



NOTE:
SEE PLATE 5, PAGE 166, FOR LOCATION OF THE NORTH ARLINGTON, STEWART AVENUE, AND WASHINGTON AVENUE OVERFLOWS.

PASSAIC VALLEY SEWERAGE COMMISSIONERS

LOCATION OF P V S C OVERFLOWS

CLIFTON-PASSAIC-RUTHERFORD AREA

ELSON T KILLAM ASSOCIATES INC
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and during periods of rainfall, or storm flow, to effect sewage quality comparisons.

For the Inactive overflow chambers, three chambers are located adjacent to pumping stations and are activated only during emergency conditions for relief of any localized flooding or for maintenance purposes. One overflow is located on the North Arlington-Kearny branch interceptor where it crosses the Passaic River for connection to the PVSC main interceptor. One overflow is located on the Lodi Force Main to serve as possible relief for this line, in the vicinity of the Wallington Pumping Station. One overflow serves a line which emanates from a single industrial source (Garden State Paper Company, Garfield). Another overflow serves a very limited area of six acres (Passaic Tail Race) located just north of the Wallington Pumping Station in Passaic.

Individual Overflow Chambers

A brief description has been prepared of each of the overflow chambers setting forth, in summary form, the results of the observations and study. These descriptions follow.

DUNDEE ISLAND OVERFLOW CHAMBER, PASSAIC

The Dundee Island overflow chamber serving this district of 195 acres is essentially residential in nature, with primarily sanitary flow. The estimated dry weather flow is about 2.0 MGD during the dry weather months, and about 2.6 MGD during wet weather months, reflecting a possible infiltration rate of about 0.6 MGD.

Metering and sampling facilities were installed in this chamber commencing September 12, 1975 and continuing through November 13, 1975. During this time, rainfall occurred on twelve occasions. However, no actual overflows were able to be recorded at this chamber.

Examination of the outflow line from the upstream manhole disclosed that the outfall line is plugged or obstructed. The exact outfall point of the outfall line was not able to be determined, since the expected point of exit to the river is covered with debris. This situation was reported to PVSC. No freeboard overflow was found to occur, only surcharging, thus no valid metering results were able to be obtained. However, sampling was performed during rainfall conditions, although no overflow occurred.

Samples taken of the dry weather flow showed that total suspended solids averaged 178 mg/l, with a BOD concentration averaging 218 mg/l, which is indicative of domestic sewage. During storm flow conditions, the total suspended solids averaged 109 mg/l and the BOD concentration averaged 164 mg/l, which is indicative of the dilution effect due to storm flows.

The sewer system tributary to this overflow is a separate

sanitary system. Consequently, no overflow is necessary, as would be required for combined flows. Whatever high flows which occur during rainfall periods are caused by illegal infiltration/inflow, which should be eliminated with future evaluations. It would appear that once these extraneous flows are eliminated, this overflow can then, in turn, be eliminated as an overflow point into the Passaic River.

PIERREPONT AVENUE OVERFLOW CHAMBER, RUTHERFORD

This overflow chamber serves a drainage area of about 96 acres. The area is served with separate sanitary sewers. It has been estimated that the dry weather flow is about 0.09 MGD during both dry and wet weather months.

Metering and sampling facilities were installed in this chamber commencing on July 12, 1975 and continuing through October 12, 1975. During this period of time, eighteen rainfalls were recorded; however, no overflows were observed. Blank metering charts were obtained which verify this absence of an overflow condition.

However, samples of storm flow were taken during rainfall conditions, although no overflow occurred. These samples showed that total suspended solids averaged 197 mg/l and BOD averaged 144 mg/l. Samples of the dry weather flow indicated an average sewage strength for suspended solids of about 50 mg/l, and for BOD the average concentration was 15 mg/l. These values are typical of very dilute sewage.

Since the flow to this chamber is low and is sanitary flow, the lines upstream should be checked for any possible storm connections, and the connections eliminated. This overflow, in turn, may then be eliminated.

RUTHERFORD AVENUE OVERFLOW CHAMBER, RUTHERFORD

This overflow chamber serves a drainage area of about 151 acres. The area is served with separate sanitary sewers. It has been estimated that the dry weather flow is about 0.14 MGD during both dry and wet weather months.

Metering and sampling facilities were installed in this chamber commencing on August 24, 1975 and continuing through October 19, 1975. During this period of time, thirteen rainfalls were recorded; however, no overflows were observed. Blank metering charts were obtained which verify this absence of an overflow condition.

However, samples of storm flow were taken during rainfall conditions, although no overflow occurred. These samples showed total suspended solids averaging 215 mg/l and a BOD averaging 151 mg/l. Samples of the dry weather flow indicated an average sewage strength for suspended solids of about 176 mg/l, and for BOD the average concentration was 135 mg/l. These values are typical of domestic sewage.

Since the flow to this chamber is low and is sanitary flow, the lines upstream should be checked for any possible storm connections, and the connections eliminated. This overflow, in turn, may then be elimina ted.

STEWART AVENUE OVERFLOW CHAMBER, KEARNY

This overflow chamber serves a tributary area of only 34 acres. The area is provided entirely with combined sewers. The average daily dry weather flow was estimated to be about 0.06 MGD during both dry and wet weather months.

Metering and sampling facilities were installed in this chamber beginning August 6, 1975, and extending through October 24, 1975. During this period of observation, thirteen rainfalls occurred and overflows are estimated to have occurred on eleven occasions. It has been estimated that overflow will occur at this chamber about 60 to 75 times per year, based upon rainfall occurrences of 70 to 90 times per year.

It was found that approximately 0.06 inches per hour of average rainfall intensity was required to cause overflow. The volume of overflow was found to range from 0.1 to 0.4 MG. However, the peak storm water overflow rate has reached 14 MGD.

Sampling of the dry weather sewage at this chamber showed that suspended solids concentrations averaged 255 mg/l and BOD averaged about 271 mg/l. This area is primarily residential in nature.

The sampling of the storm water overflow showed that total suspended solids concentrations averaged 144 mg/l and BOD values averaged only 36 mg/l. The lower wastewater characteristics for BOD are attributed to the dilution effect in this district due to storm flows.

WASHINGTON AVENUE OVERFLOW CHAMBER, KEARNY

The Washington Avenue overflow chamber serves a tributary area of about 37 acres, all of which are provided with a combined sewer system. The estimated dry weather flow was found to range from about 0.06 to 0.07 MGD during dry and wet weather months, respectively.

Under storm flow conditions in the collection system, it was found that this overflow was activated with essentially rainfalls of intermediate intensity.

Metering and sampling facilities were installed and maintained in this chamber commencing on June 5, 1975, and continuing through August 7, 1975. During this period of time, sixteen rainfall occurrences were observed. The total rainfall ranged from as little as 0.10 inches to as much as 2.55 inches. During this period of observation (which happened to fall at a time of especially heavy rainfalls), it was determined that fifteen overflows occurred at this chamber. It was found that, when the average rainfall intensity approached or exceeded about 0.07 to 0.09 inches per hour, overflow was likely to occur.

It was observed that the volumetric overflow was minimal, ranging from a negligible amount to about 0.1 MG. Peak overflow rates were found to reach 5 MGD.

The results of sampling during non-rainfall conditions showed total suspended solids concentrations averaging about 122 mg/l, while BOD concentrations averaged over 300 mg/l. Sampling during times of storm flow indicated that total suspended solids averaged about 314 mg/l and BOD concentrations averaged about 68 mg/l. The higher total suspended solids

values during storm flow were indicative of concentrated pollution due to the flushing action, which is typical of the sewage in combined sewer systems. The lower BOD concentrations during storm flow are attributed to the dilution effect of the increased flow.

GARDEN STATE PAPER COMPANY OVERFLOW CHAMBER, GARFIELD

The Garden State Paper Company overflow chamber is located in the vicinity of the driveway entrance to the Garden State Paper Company in the City of Garfield, over a 30-inch circular cast iron force main interceptor which serves the paper company plant. This interceptor leaves the plant premises and crosses the Passaic River for connection with the PVSC main interceptor, on the westerly side of the Passaic River in this area. A manually operated by-pass gate controls any overflow from this point, which is directed through a 24-inch circular cast iron outfall line to an outfall point at the easterly shoreline of the Passaic River, just south of the plant entrance.

The tributary flow, which is the total plant industrial flow in this individual line, ranged from 7.6 MGD during dry weather months to 8.9 MGD during the wet weather months. However, this difference in readings between the dry and wet weather months is due to variations in plant activity, rather than excessive infiltration in the line, since the line is a cast iron main. The extent of any infiltration in this area will be borne out with further investigation.

This overflow is classified as Inactive by PVSC. Accordingly, no metering facilities were installed at this location and no results can be presented on overflow rates, other than an estimate that, with a full by-pass, the overflow at this point would range from the 7.6 to 8.9 MGD of reported plant flow.

Sampling of the sewage flow, however, was obtained during both dry weather flow periods and during periods of rainfall activity in the area.

Sampling of the dry weather flow (during periods of no rainfall) showed that total suspended solids averaged 2108 mg/l. Sampling of the sewage flow during rainfall conditions, through the chamber screening at the siphon inlet chamber over the plant force main, showed that total suspended solids averaged 2301 mg/l, and BOD values averaged about 1064 mg/l. There was very little difference between suspended solids during dry weather flow periods and during storm flow periods (or rather periods of rainfall activity in the area), and this can be expected because the line is a force main.

This overflow is intended only for emergency use, and as such is classified as Inactive by PVSC.

WALLINGTON PUMPING STATION OVERFLOW, WALLINGTON

The Wallington Pumping Station overflow is located in the Borough of Wallington at a point just north of the inlet where the two siphon lines of the Garfield-Wallington-Passaic branch interceptor sewer begin to cross the Passaic River, prior to entering the Wallington Pumping Station. The manual slide gate located at a concrete headwall controls the overflow at the pier and bulkhead line of the river at this point. The outfall line from the inlet siphon chamber consists of a 48-inch round corrugated metal pipe. The tributary area associated with this overflow is about 2,524 acres, which is served by separate sanitary sewers along this branch interceptor.

The average daily dry weather flow in the tributary area was measured to be about 8.4 MGD during dry weather months and about 10.6 MGD during the wet weather months, reflecting a possible infiltration rate of about 2.2 MGD.

This overflow is classified as Inactive by PVSC. Accordingly, no metering facilities were installed and no results are presented herein on overflow rates.

However, sampling of the sewage flow was obtained at the siphon inlet chamber during both dry weather flow periods and during periods of storm flow. Sampling of the dry weather flow showed that total suspended solids concentrations averaged about 293 mg/l and BOD values averaged 624 mg/l. Sampling during storm flow showed that total suspended solids averaged about 134 mg/l, and BOD concentrations averaged 331 mg/l. These latter results reflect the dilution effect of the storm flows. The high

BOD values are due to the industrial portions of this sewage.

This overflow is available as possible relief for the entire Garfield-Wallington-Passaic branch interceptor, and as such, is only intended for use during emergency situations, for maintenance purposes, etc.

PASSAIC TAIL RACE OVERFLOW, PASSAIC

The Passaic Tail Race Overflow is located just north of the Wallington Pumping Station, along the westerly shore of the Passaic River, in Passaic. This overflow serves as relief for the Tail Race line, which consists of a sanitary sewer running in a north-south direction along the westerly shore of the Passaic River for a distance of about 1,250 feet, north of the Wallington Pumping Station.

The overflow line itself is a short section of pipe about twenty feet in length, constructed at right angles from a sanitary sewer manhole over the Passaic Tail Race, and leading to a concrete headwall outfall point on the edge of the river. A 12-inch manual slide gate controls the overflow. The area tributary to the overflow to the Tail Race line at this point is only about 6 acres.

The average daily dry weather flow was found to be about 0.1 MGD during both dry and wet weather months. This overflow is classified as Inactive by PVSC. Accordingly, metering facilities were not installed and no results are presented herein on overflow rates.

However, sampling of the sewage flow was obtained at the sanitary sewer chamber, at the point where the outfall line is constructed at right angles to the Passaic Tail Race line. Sampling was obtained during both dry weather flow periods and during periods of storm flow. Sampling during dry weather periods showed that total suspended solids averaged only 27 mg/l, with BOD concentrations averaging only 30 mg/l.

Sampling taken during storm flow conditions at this location showed that total suspended solids averaged only about 22 mg/l, and BOD

values averaged only about 25 mg/l. The sewage at this location is strictly sanitary sewage, with very low concentrations due to dilution.

This overflow point is very minimal in terms of importance to the system and could be eliminated. However, in the event that industrial development in this area is re-established in future years, this overflow should possibly be kept intact to serve the Tail Race line at this point. The overflow is intended to be used for emergency relief purposes, or for maintenance purposes.

LODI FORCE MAIN OVERFLOW, PASSAIC

The Lodi Force Main overflow is located at the point where the Lodi Force Main reaches the westerly shore of the Passaic River, just ahead of the Lodi Venturi Meter, adjacent to the Wallington Pumping Station in Passaic. The outfall line for the overflow consists of a 24-inch cast iron pipe leading to a concrete headwall and manual flap gate on the westerly shore of the Passaic River, adjacent to the Wallington Pumping Station. Being so situated, this overflow can bypass the entire Lodi Force Main flow, which consists of separate sanitary sewage.

The tributary area associated with this overflow is about 3,246 acres, serving the municipalities of Saddle Brook, South Hackensack, Lodi, and a portion of Wood-Ridge. The average daily dry weather flow associated with this tributary area was found to be about 5.41 MGD during the dry weather months, and about 5.52 MGD during the wet weather months.

This overflow is classified as Inactive by PVSC. Accordingly, no metering facilities were installed on the force main and no results are presented herein on overflow rates.

However, sampling of the sewage flow was obtained during both dry weather flow periods and during storm flow periods. The sewage samples were taken at the wet wells for the two pumping stations which are the major contributors to the sanitary sewage flowing in the Lodi Force Main. These pumping stations were the Mayhill Street station in Saddle Brook, and the Richmond Station in Lodi.

Sampling of the dry weather flow showed a total suspended solids average of 172 mg/l, and BOD values averaging 189 mg/l. Samples

taken during storm flow conditions indicated total suspended solids averaging 187 mg/l. No BOD results were obtained from the storm samples.

This overflow is only used for purposes of emergency relief, for possible localized flooding conditions, or for maintenance purposes.

WOODWARD AVENUE OVERFLOW CHAMBER, RUTHERFORD

The Woodward Avenue overflow chamber serves a sewer district of 206 acres. The area is residential in nature and is served entirely by sanitary sewers. The estimated average daily flow during both dry and wet weather months was about 0.19 and 0.20 MGD, respectively.

The overflow outfall line to the Passaic River was found to be obstructed somewhere between the tide gate chamber and the outfall point. The tide gate chamber was filled with water from a fire hose and the outfall point at the river was inspected for signs of flow; however, none was observed. Therefore, this overflow has been classified as Inactive by PVSC. No flow metering facilities were installed in this overflow chamber. Therefore, no results are presented on overflow rates.

Sampling of the flow was performed, however, during both dry weather periods and periods of storm flow. The dry weather sampling showed that total suspended solids averaged about 247 mg/1, with BOD values averaging about 393 mg/1. The samples taken during storm flow showed that total suspended solids averaged 135 mg/1 and BOD averaged 139 mg/1. These latter concentrations reflect the dilution effect due to the storm flows.

YANTACAW STREET OVERFLOW, CLIFTON

The Yantacaw Street overflow is located in the City of Clifton on the inlet siphon chamber where the PVSC main interceptor crosses the Third River, adjacent to the Yantacaw Pumping Station. A manual slide gate controls the overflow at this point. The outfall consists of two 5'-6" by 6'-0" arched concrete conduits which can conduct the overflow to an excavated channel leading to the Third River, and thence to the Passaic River. Being so situated, this overflow can bypass the entire flow upstream of this point tributary to the PVSC main and branch interceptor system all the way to its northern terminus in the City of Paterson. This tributary area is about thirty-eight square miles. The average daily dry weather flow was 99 MGD during dry weather months and 122 MGD during wet weather months for this entire upstream tributary area.

This overflow is classified as inactive by PVSC. Accordingly, no metering facilities were installed and no results are presented herein on overflow rates.

However, sampling of the sewage flow was obtained during both dry weather flow periods and storm flow conditions. The sampling of the dry weather flow showed total suspended solids concentrations averaging 538 mg/l and BOD values averaging 280 mg/l.

Sampling of the sewage flow during storm conditions showed that total suspended solids averaged 451 mg/l, and that BOD values averaged 259 mg/l. Dependent upon the time of sampling, the higher values indicated herein for the storm sampling would tend to reflect concentrations due to flushing action.

This overflow should be maintained, as is, for both emergency relief and maintenance purposes.

YANTACAW PUMPING STATION OVERFLOW, CLIFTON

The Yantacaw Pumping Station overflow is located at the Yantacaw Pumping Station in Clifton. This overflow is a relief line for the Rutherford-Lyndhurst branch intercepting sewer at the point where this branch interceptor crosses the Passaic River and enters the Yantacaw Pumping Station. A manual slide gate controls the overflow at this point, which is through a 30-inch circular outfall line to an excavated overflow channel leading from the vicinity of the pumping station to the Third River, and thence to the Passaic River. This overflow can bypass all of the flow entering the Yantacaw Pumping Station through the Rutherford-Lyndhurst branch intercepting sewer.

The tributary area associated with the branch interceptor is about 1,359 acres, all of which consists of separate sanitary sewers. The average daily dry weather flow at this point was found to be about 3.1 MGD during dry weather months and about 3.8 MGD during wet weather months, reflecting a possible infiltration rate of about 0.7 MGD.

This overflow is classified as Inactive by PVSC. Accordingly, no metering facilities were installed and no results are presented herein on overflow rates. However, sampling of the sewage flow was obtained during both dry weather flow periods and during storm flow periods. Samples which were taken during dry weather flow periods showed total suspended solids averaging 130 mg/l and BOD values averaging 592 mg/l.

Samples of the sewage taken at the screen chamber of the pumping station during storm flow conditions showed total suspended solids concentrations averaging 133 mg/l, and BOD values averaging 422 mg/l. These

figures reflect somewhat the effects of dilution of concentrations due to storm flow.

This overflow is used only for localized pumping station relief purposes in the event of an emergency, and for maintenance purposes.

NORTH ARLINGTON OVERFLOW CHAMBER, NORTH ARLINGTON

The North Arlington overflow chamber serves a tributary area of 560 acres. The area is provided with separate sanitary and storm sewers. The estimated average daily dry weather flow was found to be 0.93 MGD during dry weather months and 1.38 MGD during the wet weather months. This difference of 0.45 MGD represents possible excessive infiltration/inflow.

This chamber is located at the point where the Kearny-North Arlingtor PVSC branch interceptor sewer begins to cross the Passaic River for connection with the PVSC main interceptor on the westerly side of the river.

The overflow chamber consists of an outfall line, which is located immediately above the siphon line at the start of the river crossing at this point. The exact point of outfall for the overflow could not be determined, as the expected point of exit was covered with debris. It was determined from investigation that the outfall line is obstructed. Accordingly, this overflow has been classified as Inactive by PVSC. Since no metering was performed for this location, no data are presented herein on overflow rates. No overflow was observed at this location.

Samples of the sewage flow were obtained during dry weather and storm flow conditions. The dry weather flow sampling showed total suspending solids averaging 102 mg/1 and BOD concentrations averaging 242 mg/1. which is typical of domestic sewage. The sample obtained during storm flow conditions in the overflow chamber showed total suspended solids averaging 71 mg/1 and BOD values averaging 149 mg/1, reflecting the dilution effect of these sewage concentrations during storm flow conditions.

The excessive infiltration/inflow in this area should be eliminated with future investigation. Under the present conditions, this overflow chamber does have the capacity to overflow automatically, in the sense that there is a physical connection from the overflow chamber to the river (which is nonetheless obstructed at the present time). However, provisions could be made for this overflow to be operated manually, similar to the overflow arrangements at the pumping stations, so that relief for this branch interceptor can be controlled whenever emergency or maintenance conditions dictate doing so.